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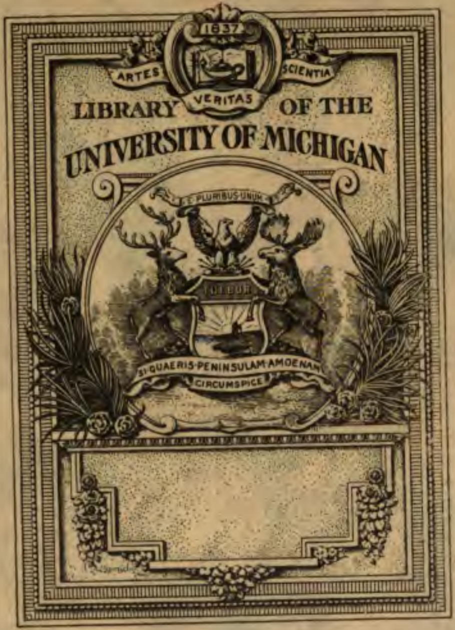
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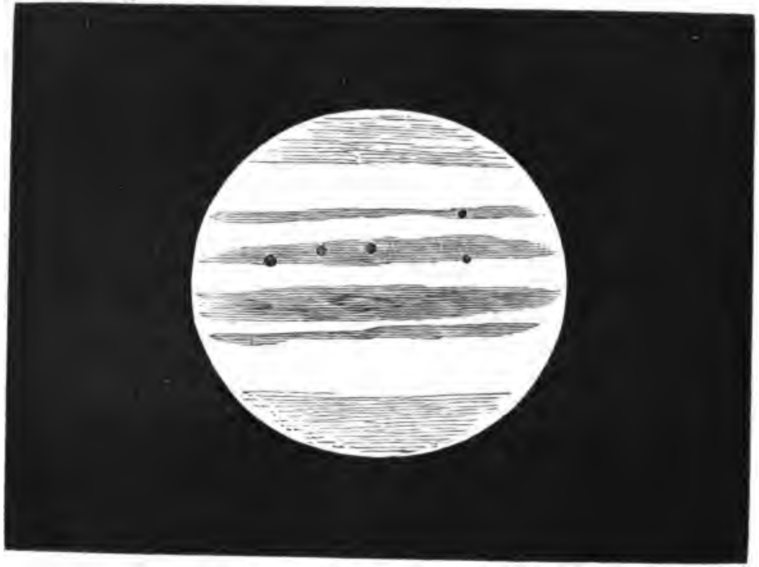

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The Astronomical Register.

No. 49. JANUARY. 1867.

ON LUNAR OBSERVATIONS.

By W. R. Birt, F.R.A.S.

As many readers of the *Register* take an interest in Lunar matters, the following method of observing Lunar details for fixing *relative position*, by which the trouble of consulting maps, drawings, or photographs *in the Observatory* may in some measure be dispensed with, may be acceptable.

In the absence of a micrometer, the eye-piece may be furnished with a pair of fine cross wires, or spider lines, placed in the focus of the eye lens. If the telescope be mounted equatorially, and provided with a clock movement, and the observer have with him a seconds watch, the operation will be greatly facilitated.

Having fixed upon the portion of the surface he wishes to observe (the neighbourhood of the terminator affords the greatest number of small objects), the first thing is to select a *known* spot —crater, mountain, or otherwise. If a crater, the N. or S. edge should be made to run along the horizontal wire in the usual way; and a conspicuous object preceding it on the wire, as well as one following it, should be noted. These will give, if the adjustments be correct, the direction of the parallel of declination which crosses the spot *at the time of observation*, as well as the alignment of the three objects *at the then state of libration.* Should the *known* object not be *preceded* by one sufficiently conspicuous, *two* following it should be noted. When this is done, the observer should bring the known spot to the centre of the field by placing it on the vertical wire and noting the second of time. He should then allow it to pass along the horizontal wire during a given number of seconds, say five or ten, if the clock is not on, but a longer period if the clock have a slower motion than that of the Moon. When the number of seconds have passed, he should note the most prominent object nearest, either preceding or following, the vertical wire; this will give another object in the same alignment, and will confine the portion of the surface under observation within easy limits.

One of these terminal points should now be brought to the centre of the field as before; and if the motion of the Moon past the vertical wire be sufficiently slow, all the intermediate and immediately neighbouring features, as crater, mountain, valley, promontory, &c., may be readily noted and inserted in the record of observation.

Having recorded the features observed, a neighbouring prominent spot, or the opposite edge of the crater—should a sufficiently large one have been chosen for the first series of observations—may be made the principal object for a second series, and so on.

If the features, the alignments of which have been given by the observations, be sufficiently but briefly described, it will not be difficult—at leisure, although as soon after the observations as may be convenient would be desirable—either to identify them on the maps, drawings, and photographs, or to determine their omission or absence, as the case may be; and if the observer be in possession of the means of symbolizing them, their relative position with respect to known and symbolized features, as well as their symbolical designations, may at once be *fixed*.

To each night's series of observations, the day elapsed of the Julian period—*Nautical Almanac*, p. xx. of every month—should be appended, as well as the Moon's latitude N. or S. to the nearest minute, and her nearest distance in hours from apogee or perigee. (See *Nautical Almanac*, p. xii. of every month.) Her latitude will indicate the direction S. or N., and her distance from the nearest apse the direction W. or E., in which the objects observed are more or less favourably situated with regard to the Moon's centre for seeing minute details.

It would be well if observers were, as a general rule, to select zones of not more than five degrees of latitude for observation. Beer and Mädler's and Lohrmann's maps (see *Astronomical Register*, January 1866, p. 25) would materially aid in ascertaining the most conspicuous objects in the zone selected; so that, whenever the Moon appeared above the horizon, and atmospheric conditions were favourable, these objects would indicate the portion of the zone nearest the terminator, and thus good observations of small and delicate objects might be obtained. Although this method would be very excellent for ascertaining features not yet placed on record, it is not proposed with a view of interfering with another and very important class of observations—viz. the study of particular regions, with a view to the production of large drawings, giving the *appearances* of objects under different states of libration and illumination, or the drawing up of monograms of such regions. The great number of very minute objects discoverable with large apertures, suggests the desirability of employing a scale for these purposes of not less than 200 inches in the Moon's diameter.

ROYAL ASTRONOMICAL SOCIETY.

Second Meeting, December 14, 1866.

The Rev. C. Pritchard, M.A., F.R.S., *President*, in the Chair.

Secretaries—Mr. Hodgson and Mr. Stone.

The minutes of the last meeting were read and confirmed.

Twenty-five presents were announced, and the thanks of the meeting given to the respective donors.

The President said: We are in a dilemma this evening—not from the paucity of papers, but from their abundance, especially on the subject of the Luminous Meteors. There is, however, one paper, being Sir John Herschel's introduction to his father's double-star measures, which claims our first attention; after which I propose to take a paper, by the Astronomer Royal, on the November star shower.

Mr. Hodgson stated that Sir John Herschel's contribution consisted of the extensive series of double-star observations made by Sir William Herschel, and all in his handwriting or that of his sister, which had been reduced entirely by Sir John Herschel, and which he (Mr. H.) thought the most interesting paper of this or perhaps any other century. In introducing the measures, Sir John stated that he found great objections existed to printing them as left by his father, inasmuch as each measure was accompanied by a diagram, to illustrate the positions, which were entered in quadrants instead of parts of a circle; and also that the measures being made with different micrometers, he thought great confusion would result, and he had therefore reduced them to the corresponding positions and measures now in use.

The President explained the part he had taken in procuring this important work, and expressed the esteem and respect he felt towards Sir John Herschel in language which he requested might not be reported.

The Astronomer Royal fully concurred in Mr. Pritchard's remarks, and said that the peculiar value of the Greenwich observations arose from the constant succession of eminent men having directed their attention to the same object; and so with the family of the Herschels, which presented a line of astronomers. He had long known Sir John, and knew how much he was desirous of keeping up his father's reputation, the latter having been the founder of Sidereal Astronomy, which, after Sir William Herschel, had been carried on so ably by his son, and had also led to the researches of the illustrious Struve.

On the November Meteors: by the Astronomer Royal.

With regard to the splendid display of the 13th ultimo, Mr. Airy said he was not able to observe many personally, but had to point out what was done by a corps of eight observers organised at Greenwich. First, as to the distribution in time: the observers looked in different directions, and they believed that it was not often that any two observed the same meteor. Notwithstanding the inevitable fatigue of watching, and the necessity of some pauses for refreshment, &c., 8,500 were counted, and the general idea was that about 12,000 were really seen. The numbers in each five minutes were counted, and Mr. Glaisher had thrown the result into the form of a curve in the diagram exhibited. From 11 to 12, but few meteors were seen; after which they occurred in great numbers, the maximum being at 20 minutes past 1; after this they decreased, but presently made a fresh start—a fact corroborated by other communications received. The number shown by the diagram in successive periods was probably more accurate than any previous estimations. Next, as to the point of radiation, Mr. Airy referred to two charts—one produced from the Greenwich observations, the other sent by Mr. Alexander Herschel. In the former, the results of only the four best observers were used. In both charts a singular deficiency of meteor paths would be noticed on one side, and that the side of the heavens which was rising. To understand this, we must consider the motion of the earth in its orbit and on its axis; and as some assumption or theory must necessarily be made as to the meteors, we suppose them to be bodies somewhat like marbles, travelling in space. Then, so long as the point of observation is on the following side of the earth, we shall see no meteors; but when rotation brings the observer to the position that his motion coincides in direction with the point the meteors are in, and is advancing towards them, they will become abundant. Thus, there is always a deficiency on the side of the rising stars. If γ Leonis and ϵ Leonis were joined by an arc, the point of radiation would be 1° north of the middle of the curve. This is shown by both charts. The first determination of this point was received from Mr. Herbert Airy, who had to take a walk at Cambridge between 4 and 5 o'clock in the morning, and noticed the radiant point very carefully; all the subsequently received observations concur in showing the same position. The divergence is only an effect of perspective, being the direct opposite of the vanishing point. As to the effect of the resistance of the air, or the earth's attraction influencing their paths, Mr. Airy thought at present these effects were doubtful. Had the meteors been stationary, they would have been seen always in the point to which the earth was advancing instead of 11° north of it, and moving perpendicularly to the plane of the ecliptic. The Astronomer Royal had made a rough mathematical investigation of their paths, and found that the inclination of the orbits of the meteors was about 19°. He also wished to call attention to two papers on the subject, by Mr. Newton, in the "American Journal of Science," some years ago. These collect the original accounts of the star showers from the earliest time, and show their probable recurrence about every 33 years. Mr. Newton's general idea is, that there is a ring of meteors moving in an elliptical orbit, the motion being retrograde, and the period about 354·6 days. We thus get the recurrence of the masses in about 33 years. These papers are the standard authorities up to the time they were written; and Mr. A.'s present paper and similar ones were a step forward in the discussion of the interesting subject. Mr. Alex. Herschel saw a meteor standing still and blazing at him; and Mr. Lynn saw the same thing. Of course this meteor was coming directly towards us. He (Mr. A.) trusted that the display would now be regularly looked for. The last American advices stated that, although many meteors were seen on the preceding and following nights, the great display was not seen there at all. We were now in a different stage of knowledge on the subject. Formerly we only knew we *might* see such a shower; but now we know the definite part of the sky from which they would come, and that it was no use looking out at 8 or 9 o'clock, but only in the early morning hours when that point was well risen above the horizon.

On the Anticipated Disappearance of all Jupiter's Satellites at once.

This was another paper by Mr. Airy, intended as a warning to all who liked to see extraordinary sights. Mr. Dawes once saw Jupiter without any satellites, and there was another similar observation recorded somewhere.* On August 21st next year, Jupiter would be seen without his moons for 1¾ hour, and the observation may be made in this country. On several days—August 12th and 28th, and September 4th—three satellites will be hidden simultaneously, but not the fourth. There is a law that when the first and third are eclipsed, occulted, or otherwise hidden, the second, being exactly opposite, is also invisible, so that three often disappear; but for all four to be absent is very rare.

Mr. Airy also stated that on last Tuesday night, at 17 minutes past 12, the watchman at Greenwich Observatory felt a smart shock, and he would be glad to know whether it had been felt by anyone else, and whether it could be traced to an explosion of gas or gunpowder, or was an earthquake.

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* There are several—Molyneux, November 2, 1681, o.s.; Sir W. Herschel, May 23, 1802; Wallis, April 15, 1826; and Griesbach, Sept. 27, 1843.—T. W. B.

The President: Now comes our dilemma. What are we to do with the mass of papers we have received on this subject? They are far more than can be read even in abstract to-night. So far as I can see, we had better read a letter from Sir John Herschel, stating what he saw; and then if any gentleman who has sent us a paper will come forward and read it himself, and allow me and others to ask him some questions upon it, I think we shall elicit all the information time will permit.

Mr. Hodgson suggested that an abstract of Mr. Newton's papers should be given in the Monthly Notices as a starting-point of information.

The President: Mr. Newton's great point is that from A.D. 900 to 1833, there have been star-showers recorded about every 33 years, or some multiple of that period. Sometimes they occur three years in succession; at others, one or more are dropped. It is therefore likely there may be another shower next year; but perhaps an hour or two later. I should also like to ask the Astronomer Royal whether a great astronomical problem is not involved in these meteor showers?

The Astronomer Royal quite agreed with Mr. Hodgson's suggestion.

On the November Meteors: by Sir John Herschel.

The author stated that his attention was principally directed to determining the radiant point. This has been generally said to be near γ Leonis; but the real point is higher, being in long. 142° 10′, and lat. 10° 15′ N. Several circumstances concurred in making him fix on this as the radiant point. On three occasions meteors were seen in the very spot, devoid of trains, and on extinction left only a nebulous light. In one case a meteor 6° or 8° from the radiant point left a vaporous train which lasted 2m. 40s., and afforded time for tracing its course back to the point in question; and the calculation from the earth's place, compared with this point, shows that γ Leonis is not the precise focus of divergence. Most probably the meteors are moving in a circular orbit of nearly the same diameter as the earth's, but in the opposite direction, with an inclination of 19° 53′ to the ecliptic. A more persistent train than the one noticed was seen near Sirius. It was bright for six minutes, during which it drifted southwards, changing its direction till it was at right angles to its original position.

The President: I noted the radiant point, and marked it on a map. Three days afterwards Sir J. Herschel's letter arrived, and I found the place agreed with his.

Mr. De la Rue, at the President's request, narrated his observations. The night of the 13th–14th November was fine, with a few occasional clouds. The wind was high, and it was very cold. The noise caused by the wind and the trees prevented any sound from meteors bursting being heard, supposing such had been produced. Mr. De la Rue was assisted by Mr. Reynolds and a nephew; and although he had often seen finer individual meteors than any on this night, the magnificence of the display for number was wonderful. The greatest number was seen between 11h. 45m. and 1h. 20m. At 1h. 43m. the number per minute was sensibly less. With three exceptions, all radiated from Leo. Those seen exactly at the radiant point appeared as bright specks which got brighter, and then faded out. Orion and the Great Bear were specially favoured. One train lasted three minutes; others were observed to break and curl up, drifting the whole of the time. One, which lasted 2m. 13s., gathered into a spiral form, and several nebulous masses were picked up with an opera glass, which were parts of the trains left by meteors not seen. About 1 o'clock the continuous shower was like the "bouquet" of a display of fireworks, but having a downward rush to the western horizon, instead of upwards.

The President: Not one of the spectroscope observers seems to have succeeded.

Mr. Browning: I have sent a paper to Mr. Alex. Herschel stating I saw differences in the spectra of some meteors; not lines, but in some the colour was nearly all yellow—in others the yellow preponderated—one had a sharp yellow line and two green ones.

The Astronomer Royal: Mr. Glaisher informed me this morning that of all the papers he had received, not one recorded a distinct observation of the line D. This line is so easily produced by accident, such as opening and shutting a book sharply, when looking at a flame, that we are anxious its presence should be distinctly proved.

Mr. Browning: When the train was homogeneous in colour, the spectrum was so too.

Mr. De la Rue: To produce the line D by accident, the sodium dust must be heated. This could not happen in observing meteor spectra, no lamp being present. Mr. De la Rue continued his account. The general colour of the meteors was blue—sometimes green. At 12h. 41m. he only counted 4 in a minute; at 1 o'clock, 21; from 1h. to 1h. 20m., 33, 37, and 33; and Mr. Reynolds, looking the other way, 31, 29, and 30. The two observers estimated they noticed two-thirds of all that passed. At 1h. 50m. the number was 25 per minute; at 2h. 25m. only 3; and at 2h. 27m., 14 in the same time.

The President: These maxima and minima may be of great importance in fixing the shape of the ring. I think we may come to the conclusion that we have no very great evidence of their nature from spectrum analysis, but only approximative. I would ask Mr. De la Rue, who has a good eye for colour, whether he saw, as I did, any change of colour in the trains. I made a list of 53, of which the times were taken. One shot across Orion, became nearly extinct, and then burst out again.

Mr. Browning: You must not expect the same evidence as when looking at stars with an ordinary spectroscope. The very construction of the instrument for meteors precludes any sharp boundary of the spectrum or lines. All that you can get is diffused light and differences in it.

The Astronomer Royal: But not long ago D was seen in the same instruments, while it was not observed now.

The Rev. F. Howlett: I was up the whole night, and have sent in a paper containing the numbers seen and the courses of 50, for reduction by Mr. Glaisher. The colours are noted, and the hour and minute just before explosion given. Many assumed a ruddy tint at the end of the train.

The President: There are many records of three changes of colour.

Mr. Lockyer: The colour was generally pale straw, then green or blue, and afterwards ruddy. Sometimes these tints were most beautiful. Another thing may be important. In some cases the trains seemed to cease; that is, there were intervals between the meteors and their trains. Professor Phillips has noticed and sketched this appearance, and Mr. Marth also observed it. There may have been not only the explosion of the meteors, but incandescence of our atmosphere.

The President: Has the spindle form of train been observed by anyone here?

The Astronomer Royal: Many noted this form.

Mr. Stone: Is it meant by this that the broadest part of the train was central?

Professor Adams: One part of a train was often more persistent than the rest. The centre would remain after the ends had faded out—often a minute longer.

Captain Noble: The form of the train was spindle-shaped in several; one was very persistent, and lasted five or six minutes, till a cloud obscured it. This was about 1h. 11m. I did not see the meteor; but the train when noticed was long, and like the nebula in Andromeda. I then fancied—but it may have been only fancy—there was some spiral motion, after which it became squarer, and the clouds covered it.

The President: We have done with colour and form. The very same maxima and minima were observed at many places besides Greenwich. This is not without a meaning, and may tend to show the form of the stratum of meteors. Can any member present corroborate the fact?

Mr. Howlett: I kept a record the whole night, and believe that between 1h. 2m. and 1h. 10m. there were 200 per minute. There were numerous lulls, and then increased outbursts. I noticed this in my communication to Mr. Alex. Herschel, and put a note of interrogation to it.

Professor Adams: Every observer noticed these lulls, and also that at particular moments the meteors affected particular parts of the heavens more than others. There might be very few at one place, and in another direction the display would be magnificent. I did not notice any but one radiant point, as some persons did.

The President: There were several other distinct radiant points.

Mr. Chambers: I saw several meteors diverge from the constellation Pegasus.

Professor Adams: There were plenty of stragglers, but no other marked radiant point could be fixed on.

Mr. Stone corroborated this statement.

Mr. De la Rue: There were very many meteors converged to Pegasus, but none radiating from it.

The President: This discussion will serve to guide observers in future as to the points requiring attention. It is quite certain that good observers affirm there were other radiant points.

Mr. Howlett: I saw only four exceptions—two intersected in the Great Bear, and two in Orion.

The President: The subject has become a cosmical-astronomical one, and must now get into the hands of the mathematician.

Mr. Howlett: How will they deal with such as one which took a curvilinear path round the Pleiades?

Mr. De la Rue: The Zodiacal light was seen on the night in question, and there was a glow in the sky round the radiant point. Now, these meteoric bodies going round the Sun would reflect the Sun's light like the planets: might it not be possible to see them by this light on other occasions? The Zodiacal light itself may be a mass of such dust.

The President: We have a large mass of meteoric matter revolving in an orbit nearly circular in 354 or 365 days, at an angle of 19°: cannot some of our big telescopes show these bodies?

Mr. De la Rue: Or might they not be seen with the unassisted eye?

The President: One observation amounts to this: the observer did not go to bed till sunrise, and was rewarded by a brilliant display of the Zodiacal light, the apex reaching to Leo. Now, everybody during the star shower noticed a phosphorescence or glow in this quarter: might it not have been the Zodiacal light?

Professor Adams said that he proposed to give some information as to the elements of the orbit of the meteoric ring, deduced from his observations of the radiant point, on the determination of which such orbit depends. He did not know whether Sir J. Herschel assigned any limits of error to his result, but his (Mr. Adams's) differed a little from it; his observations were made about 1h. 15m., and were not upon meteors in Leo, which looked mere points, but upon those near, which, leaving short trains, could have them traced back. The five stars of Leo were laid down very accurately on a chart, and then the intersecting paths showed the true centre of the ellipse to be in long. 143° 20′ and lat. 8° 56′. [The President: This is lower than any other result.] From this determination all the elements of the orbit were deduced. He had taken Mr. Newton's period of 354 days, although he was not quite satisfied with it. This gives the major axis, and hence the velocity and true direction can be calculated. The inclination was 18° 7′, and the actual velocity 18 miles per second, which, being opposed to the Earth's motion, made the relative speed about double, or 36 miles. He had used the latest and larger solar parallax, and smaller dimensions of the Earth's orbit, which made his result different to others. The Earth's longitude was 51° 28′, and its centre would be moving in a tangent to its orbit and to a point 90° distant if that orbit were circular; but it is really elliptic, and we on the Earth's surface are moving round its centre, so that the actual direction of the spot is a little different. The correction due to both causes is 55′. The point 90° in advance of the Earth is 141° 28′, which corrected gives 142° 23′, my determination. Herschel's is slightly less. The meteors are moving outwards, and crossing our orbit at a small angle. The eccentricity is between ·04 and ·05.

The President: When all the radiant points are before you, I trust you will give them their proper weights, and re-compute these elements.

Mr. Hodgson: I should be glad to hear of a meteor which at 3h. 6m. burst apparently so near me that had anyone else seen it the distance could be ascertained.

Mr. Stone said he had an unpleasant duty to perform; but having written to Professor Watson, of Ann Arbor, to know whether Mr. Barker's letter of May 17th contained, as he stated, a full account of his observations of T Coronæ on May 4th, 8th, and 9th, he had received an answer that Mr. Barker's letter gave no particulars of such observations, but merely said that, referring to the observation of May 14th, he (Mr. Barker) thought he had seen a strange star there about a fortnight earlier, and if so, it was equal to α Coronæ. The alleged observations were therefore mere conjecture, and worthless as proving the brightness of the star earlier than May 12th.

After notice that the next meeting would be made special to consider the byelaws relating to the medal,

The meeting (which was very crowded) adjourned.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

CONCEALMENT OF THE LUNAR CRATER "LINNE."

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Herr Schmidt, the Director of the Observatory at Athens, writing under date of the 17th of November 1866, announces the interesting fact that the crater "Linné," of about 5·6 English miles in diameter, situated on the *Mare Serenitatis*—its position as a point of the first order, determined by Lohrmann and Beer and Madler, being 11° 32′ 28″ W. longitude, and 27° 47′ 13″ N. latitude—has disappeared. This illustrious astronomer, who has devoted more than a quarter of a century to the study of the Moon's surface, has known the crater "Linné" since 1841, and had never found it difficult until October 1866, when, instead of the well-marked *deep* crater, he saw only a glimmer—a little whitish cloud—in its place, and this he found to be the case in November. On both occasions the Sun was at a low altitude above the horizon of "Linné," when similar craters are seen with the greatest distinctness.

This, I apprehend, is most probably an instance of concealment; and perhaps if observers keep an attentive watch on the object, some addition to our knowledge of lunar physics may be obtained. Schröter records several instances of distinct objects having been obscured, and the pages of the *Register* bear testimony to one or two recent instances perhaps of the same kind. In Vol. ii. p. 10—Jan. 1864—is a notice of the second cone in Tycho, which I believe had not been placed on record previously. For a long time before I saw it, I found great difficulty in "looking into Tycho;" I could never get it, as I imagined, into focus. In connection with this subject, but of an opposite character, Mr. Hunt's letter, preceding mine, will be read with interest.

As to the probability of *new* craters being opened on the Moon's surface, allow me to refer the reader to Vol. ii. p. 183—August 1864; also to the same vol. p. 295—December 1864. In the last communication, a similar appearance to that described by Herr Schmidt is mentioned, and it was in the locality of the *whitish cloud, when it had passed away*, that Mr. Knott discovered the pair of minute craters $1C^{\mu^2}$ and $1C^{\mu^3}$ on December 12, 1864 (see Vol. iii. p. 263)—November 1865. In Vol. iii. p. 189—July 1865, p. 207; August 1865, p. 252; October 1865, the reader will find various notices of the same interesting region.

It is to be hoped that observers, especially those who have large apertures, will from time to time carefully scrutinise the regions alluded to on the *Mare Crisium* and the *Mare Serenitatis*. The neighbourhood of Carlini, on the *Mare Imbrium*, to which Mr. Williams's communication—Vol. iv. p. 15, January 1866—refers, is also likely to afford phenomena of the same character.

Begging the favour of an early insertion,

I remain, your obedient servant,
W. R. BIRT.

Victoria Observatory, 42 Sewardstone Road West,
Victoria Park, London, N.E.: November 30, 1866.

P.S.—December 14, 1866, 4.45 G.M.T.—Observed Linné, and found it, as Schmidt describes, a diffuse patch of light of probably not more than 3°. This is a rough estimate, as clouds were passing. Definition very good when I first saw the spot. The *crater* is certainly obscured. No shadow visible; nor could I see into the crater. The two craters, A and *b* of B and M, west of the streak across the Mare Serenitatis, both smaller than Linné, are very distinct with the shadows within them.—W. R. B.*

THE NOVEMBER METEORS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—It is impossible adequately to describe the beautiful meteoric display which was witnessed in this locality by thousands of spectators on the evening of the 13th of November and the morning of the 14th. During the day the weather was tolerably clear and fine, and presaged a suitable evening for observation; but as daylight waned a severe storm of rain and a strong gale from the NW. swept across the earth, and the heavens were wrapped in blackness. At 7 o'clock the clouds cleared off, and the stars, in countless myriads, shone resplendently. From 7 o'clock till 11 occasional meteors shot across the sky, the *avant couriers* of the coming army, but not more in number than are usually seen on a clear November evening; they were sufficient, however, to raise the expectant spirits of outlookers, who had been sadly disappointed by the unusual absence of meteors on the previous evening. At 11 Leo Major began to rise majestically from the eastern horizon, and luminous meteors, with trains of various degrees of brilliancy and permanence, shot across the heavens. The number visible from 11 o'clock until about 12 averaged about three per minute, and with rare exceptions all rose from the horizon in the neighbourhood of the ascending Leo, or, if not springing from the horizon, the radii carried backward converged upon that point. From 12 till 1.15 the display rapidly increased in grandeur and brilliancy, and at 1.15 arrived at a maximum, at which time one pair of eyes alone directed towards Leo saw upon an average two meteors per second, and occasionally ten or twelve were visible at the same instant. During the entire night the sky was unclouded. All the lines of flight converged on Leo Major, and the point towards which they appeared to converge was one about 1° south of γ Leonis. About 50 per cent. of the meteors were without trains, and the remaining 50 per cent. had trains of greater or lesser brilliancy. Some trains emitted a white light; others were light red; but the majority were either faint blue or a more or less deep green. With the exception of those afterwards referred to, few of the trains remained visible more than eight seconds, and the majority not more than two or three seconds. Several of the meteors visible on the horizon near to Leo, and in the neighbourhood of Cancer, had a distinctly globular form, and well-defined discs, as large as that of Jupiter when seen through a good terrestrial prospect glass. One globular meteor passed northward along the horizon. One appeared double, and the nuclei rolled over each other during their passage. Two were seen to burst into large fragments; but the vast majority sped steadily and smoothly across the heavens, and became suddenly extinguished.

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* The following note appears in the *Athenæum*:—

"On Thursday evening, December 13, I spent a couple of hours with Mr. Birt and Mr. Talmage, at Mr. Barclay's Observatory, Leyton, examining the spot with the 10-inch refractor. During this time the moon was constantly covered with a very fine veil of cloud, but Bessel and its shadows were very distinctly visible. No trace of Linné to be seen. Our impression was that Linné ought certainly to be visible under the circumstances, which allowed such very distinct observation of the neighbouring Bessel. I have this morning a note from Mr. Talmage to inform me, that after Mr. Birt and myself had left the Observatory, under the impression that all further chance of observation was gone, the clouds suddenly cleared quite away, giving him an unexceptionable opportunity of examination. He then found that a spot he had previously taken for Linné was Sulpicius Gallus, and that *no trace of Linné* was visible, but that where *it* should be there was a faint circular cloud-like spot ('petit nuage blanchâtre' of Herr Schmidt). Mr. Talmage was enabled carefully to verify the fact that the cloud occupies the exact position that the crater Linné should hold.

"ROBERT JAMES MANN, M.D."

From 1.15 to 2 o'clock the meteors gradually declined in number, but not in brilliancy; and after that period, until Leo had risen nearly to the meridian, occasional beautiful meteors appeared, showing Leo as a focus of emanation; indeed the display during the whole night seemed as though celestial fireworks were being shot from a huge revolving mortar in that part of the heavens. At 2.10 a beautiful and very luminous meteor passed through Cassiopeia and onward to β Pegasi, where it became extinct; but left a long line of luminous matter, which became gradually condensed into a cluster not unlike a faint nebula when seen through a telescope; the line and cluster moved about 5°, and remained visible for four minutes. At 2.40 a very fine meteor—indeed by far the finest I witnessed during the night—exhibited itself, passing from Leo north of α and β Ursa Majoris, skirting Polaris, and becoming invisible near Alderaman in Cepheus. It left a train like a strong shaft of molten silver several minutes in width and about 15° in length, which illuminated the entire neighbourhood.

This beautiful luminous train became gradually bent and distorted, like a typical serpent or an open skein of silk when thrown upon a table; it continued slowly to bend, until it assumed the shape of an irregular L, and finally resembled the jaw of a whale or horse-shoe, which covered the entire area of Cepheus, the summit of the arch pointed to Ursa Major and curved round β Cepheii. This phenomenon was visible 15 minutes, and very distinctly 10 minutes.

At frequent intervals during the night vivid flashes of light rose from the Eastern and ESE. horizons; they were sudden and circumscribed, unlike ordinary lightning flashes. No reports were heard at or after the bursting or disappearance of any meteor. On the zone or belt meteoric theory, I confess myself at a loss to account for the apparent radiation of all the meteors from the point in Leo, and see special difficulties in the fact that not one of the thousands seen crossed a small circle about 5° in diameter south of γ Leonis. Will any of your readers please to enlighten me, as by so doing they would confer a favour on other amateur astronomers to whom the same difficulty has presented itself?—I am, yours respectfully,

Newcastle-on-Tyne: Nov. 19, 1866. T. P. BARKAS.

Sir,—I do not know whether I can add anything of interest to the numerous communications already sent to you concerning the star shower of last month.

On Monday, November 12, at 6 P.M. there was thick darkness, and onwards till I went to bed. This surprised me, as the moon did not set till a quarter past 8. At 3 next morning I looked out and noticed a luminosity to the south and west, which I could only ascribe to the nebulous atmosphere into which we were entering, Some stars, which I guessed to belong to Orion, loomed large through the mist.

On Tuesday evening there were occasional shots, like the advanced skirmishing of an approaching host. Lightning flashes appeared in the horizon. Being rather fatigued by unusual exercise, I did not think it necessary to station myself at a NE. window till near 12. My longitude is 25′ 40″ W. of Greenwich, and by so much sooner the celestial *pyrophasis* was earlier in London. I soon saw that counting would be hazardous to accuracy, and I got a blank book and with a pencil made a stroke for each observation. Towards 2 they began to be less frequent; but on going to a window looking to the SW. I saw them still numerous. I attempted in some instances to indicate the length of the trajectory. Thus many were only 2° or 3° long. They were denoted by a line ¼ inch. But I found some lines 3 inches long = 30°. Towards the horizon there were clouds, and the sudden outburst there was like a bull's-eye lamp flashed through the misty night.

The total number in my book was 487, which I estimate as about a quarter of what might have been counted. Or if the visible sky be taken as a term of the ratio, 20 times this number might have been counted = 9,740.

I am, Sir, yours, &c.,

Portadown: Dec. 14, 1866. T. B.

THE EQUATORIAL AS A TRANSIT INSTRUMENT.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Having been for some length of time in possession of a 6-inch telescope, by Cooke, of York, which was made with the view to its being used not only as an equatorial, but also, if possible, as a transit instrument, it may perhaps be of interest to many amateurs to know how that object has been satisfactorily attained, as, for a period of more than twelve months, I have been enabled to get the time to within half a second.

The instrument is made, I believe, as true as hands can make it, and every care has been used to set it up as properly as circumstances will permit. The foundation is a bed of several courses of brick laid on the sand of which the ground consists, and on the bricks is a large thick flag nearly a ton weight, which was placed in its present position, and very carefully levelled, some time before this telescope was put upon it. The instrument itself weighs nearly a ton; and although it has been now more than two years in its present position, the flag is as level as when it was first set upon it.

I have been particular in this description, as many persons might say that their instruments are not well placed, and therefore they never could get the time properly; but I think that, with care, anyone with an equatorial, properly mounted as such, may by this plan get the time very well, although the foundation may not be quite as good as might be wished.

The first thing to be done is to get the instrument placed as correctly as may be, and I attach great importance to its being perfectly upright. I am not writing for any but my fellow-amateurs, and consequently don't intend to go into the science of the matter, or consider how the equatorial attached to a regular observatory ought to be fixed. I merely suppose that the amateur has got his telescope so placed that he can find the stars readily in the daytime—as, if he can do that, the rest is tolerably easy. His transit eye-piece must be pretty nearly adjusted for collimation, and it is recommended that he should use it so that the stars come into view, and up to the first wire, always on the same side of the eye-piece. In my own practice, I am content to use only *Nautical Almanac* stars, from the zenith to as far south as I can see. It is presumed that he has determined his longitude pretty correctly, and from some source or other to know his correct sidereal time, and, moreover, to have on the instrument a sensitive level.

If now he will level the instrument as carefully as possible, *after* setting on to a star as near the zenith as may be, and note the transit, he will find out the error of his instrument, or his level, and he is ready to begin to set it right the next time he observes the star.

When the star comes into the field, let him note the beats of his clock, and, with his hand on the "slow motion," he can pretty nearly *put the star* on the *first* wire at the correct time when it ought to be *there*, and then he can note when it is on the middle wire, and if he has hit the mark the middle wire will give him the right time for that star. He must then look to his level, and, if necessary, alter it so as to *make* it read correctly. It is absolutely necessary to success that the level should then be firmly fastened to the instrument, as no levelling in the ordinary way will answer at all. Let him observe the same star at the next opportunity, setting as before on the star, and then levelling with the slow motion, and if he has succeeded in getting the time correctly, all well; if not, *make* the star, as before, come to the wires at the right time, and alter the level. The great secret is to get the level right, and he must persevere until he gets the level to tell him when his middle wire is in the meridian. To this end it must be fast to the instrument, and have as long a bubble as possible.

Having got the time correctly with a zenith star, let him set on a low star south, and then level as before and note the transit. If he gets the time correctly his instrument is right, and he will have his reward for his patience in always afterwards, with using due care, getting the time correctly. But should the low star give a different time, the error is in placing the instrument, and it must be moved in azimuth so as to make it correct.

It is, perhaps, easier to describe all this than to do it; but whoever wishes to be able to get the time for himself, being only in possession of an equatorial, will not find his labour thrown away, because when it is once set right, my experience justifies me in saying that he can get the time as well with that as with a transit instrument.

But four things are necessary—viz., a properly-made instrument, a sensitive level (having a long bubble) made *fast* to the instrument, the correct sidereal time at the place, and a fair stock of patience.

The following are the results of one night's observations which I got after fixing mine, and I shall be glad if they induce others, with suitable instruments, to set about doing the same for themselves:—

		° ′			″	
β Draconis	+	52·24	Chronometer error	+	57·63	highest star.
μ Herculis		27·48	"	+	57·52	
γ Draconis	+	51·31	"	+	57·42	
μ′ Sagittarii	−	21· 5	"	+	57·51	lowest star.
α Lyræ	+	38·40	"	+	57·86	largest star.
β Lyræ		33·13	"	+	57·49	
ζ Aquilæ		13·40	"	+	57·54	
ω Aquilæ		11·21	"	+	57·36	
δ Aquilæ	+	2·51	"	+	57·35	
			Mean . .	+	57·52	

It may, perhaps, be desirable to mention that I always leave the instrument levelled and ready for taking a transit, as by that means the spirit in the level is settled by the time I want to use it, and I have only to make the final adjustment just before taking the time.

I am, Sir, yours respectfully,
Waterloo, near Liverpool: JNO. JOYNSON.
13th Nov. 1866.

THE PLANET MARS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Allow me to thank Mr. Proctor for the kind manner in which he has pointed out the error I am sorry to find I have made respecting the diameter of Mars. The reasons he adduces for the smaller apparent diameter occurred to myself also, but I deferred to the authority of the *Nautical Almanac*, and the more so as the figures given therein appear in an Ephemeris for the opposition, specially.

On looking more closely, however, I am glad to find that it is not "from the little care with which the column of semi-diameters is drawn up" that a magnitude apparently larger is assigned to Mars for 1866-7 than for 1864, but that a new value has been adopted for the planet's semi-diameter at the mean distance of the Earth from the Sun. In the prefaces of the Almanacs to 1864 inclusive, it is taken from "Littrow's Astronomy" as 4″·43, but for 1866 and subsequent years, from Le Verrier's Tables, as 5″·55; and this very considerable difference will account, I presume, for the larger diameter the columns for 1866-7 exhibit.

Had I been aware of this change, I should not have included a greater magnitude among the circumstances favourable to observation at the present time; because, whilst 17″·4 is assumed to be correct for 1866, a change in the value of the semi-diameters for 1862 and 1864 would be required before they could be compared with that adopted for 1866, and were that made, the last would doubtless then appear to be the smallest.

Mars is, nevertheless, still large enough to allow the details of his surface to be well seen with instruments of moderate size, especially when the atmospheric conditions will allow of the use of high powers. On the 8th, in particular, the light of the North Pole was intensely bright, and three brilliant spots or points in it seemed, from irradiation, to project beyond the disc, so as sensibly to impair its figure, somewhat like that in one of Mr. Green's drawings, No. 4 (*Register*, vol. iii. p. 71).

I am, Sir, your obedient servant,
Ealing: Dec. 15, 1866. W. L. BANKS.

NEW (?) DOUBLE STAR NEAR ALBIREO.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I thank your correspondent, Mr. R. J. Gould, for his letter in this month's *Register* relative to the above. If he will please understand my expression *between* to signify on the *line* from Albireo to γ Lyræ, allowing my other directions to stand, he will, I hope, soon light upon the very pretty object in question.

I may add, that I used the word *between* in a general and popular sense, and that one or two friends have already found the double from my description.

I would also interest some of your subscribers in the double star δ (delta) Cygni, which deserves attention on account of the *great* difficulty of separating the components. A friend of mine has divided them frequently with about 300 on an aperture of 4½ in., while another, with an excellent achromatic of 8½ in., always fails in the attempt.

The other night another friend and myself saw the star quite distinctly, elongated with a 5 in. aperture. I am anxious to know what may be the experiences of other observers; and if they would, through your medium, favour me with them they would thereby oblige,

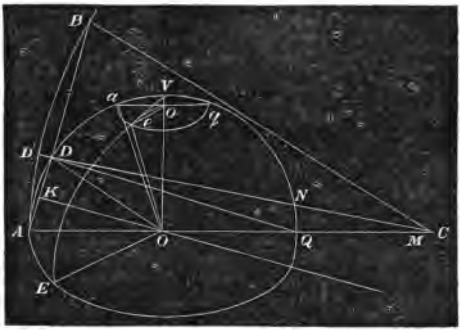
Sir, yours faithfully,
W. E. JONES.

The Warren, Bushey Heath, Herts :
December 5, 1866.

TRISECTION OF AN ANGLE.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Having never seen any good reason assigned for the assertion that an angle cannot be trisected with mathematical correctness, and having myself found the results of all attempts, however closely touching it, to be only approximations, and therefore failures, excepting those which depend upon the principle of the epicycloid, I venture to send you a few of these, fancying they may be interesting to some of your readers.



1. Let ACB be the given angle. Take AO equal to one-third AC. Draw OD parallel to CB. With centres C, O, describe the arcs AB, AD. Let the arc AD be caused to roll upon the arc AB until the point D comes in contact with it in any point D′; join D′C. Then the angle ACD′ will be one-third the angle ACB.

2. Take CQ equal to one-third CA. Join QD and produce it. Join AD and draw OK at right angles to AD. Let the arc or line AD be caused to move so that its extremities A, D, shall be always on the lines QD produced and AC until KO produced shall pass through the point C. Join CD. Then the angle ACD will be one-third the angle ACB.

3. Complete the semicircle ADQ. Through D draw a straight line DMM, cutting the circle in N, and the line AC in M in such a manner that the portion NM shall be equal to the radius OA. Then the angle AMB will be equal to one-third the angle ACB.

4. Let AVQ be a hemisphere having vertex V, and base the circle AEQ radius AO, and the given angle AOE. Join VO. Take a section of the hemisphere by a circle *aeq* parallel to AEQ, having its centre *o* on the line VO and radius *ao* equal to one-third OA. Let VA, VE be arcs of great

circles cutting the circle aeq in a, e, making the $\angle aoe$ equal the angle AOE. Join aO, eO. These lines aO, eO will be on the surface of a cone having for its base the circle aeq and vertex O. Then the portion aOe developed will have the angle aOe equal one-third the angle AOE.

For the second and third of these methods a trisector combining the principles of the sliding and parallel rules may be easily constructed.

I am, Sir, faithfully yours,

E. J.

STELLAR SPECTROMETRY.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—On perusing your very good *Astronomical Register*, which I have had through a friend (Mr. Freeman), I have seen in the Number for November, page 290, some remarks which require a little explanation from my own side.

Speaking about spectrometry of the stars, the writer justly remarks that in the phrase "and white *lines* of the type of α Lyræ and Sirius are very frequent," there must be an error. So it is indeed; and instead of *lines*, one must read *stars*.

What is subjoined, however, of the star γ Cassiopeia, and where it is, spread some doubt about the reality of the phenomenon. I must say that I have seen it several times, and *I am sure* of it, and shown it also to several others. The doubt of the reality of the phenomenon, because not formerly noticed by Mr. Huggins, is of no weight at all. I am sure that if he observes the star with a sufficient spectroscope, he will see it. I do not, however, warrant that he will be able to see it with a slit spectroscope. My spectroscope has the great advantage of absorbing very little light, and of an easy change of the prism and eye-piece. The eye-piece is by no means indifferent: a too great dispersive power for some objects is as dangerous as an insufficient one. I find that a power of 400 or 500 is the best for this object.

My prism has a natural divarication in the dispersed pencil of light of 6° between the lines B and H of the solar spectrum; hence I think it by no means to be thought as a weak instrument, especially for stellar spectrometry. I have not seen any of the publications where Mr. Huggins, before me, speaks of this brilliant line, and therefore I have at least the merit of an independent observation. I cannot indeed reconcile the end of the letter with the beginning. On the line 13 (ascending), the writer says that Mr. Huggins has seen it; and in line 27 (ascending), he says, "if verified." How this may agree with the other is quite inconceivable. Besides, the writer makes a confusion of two very distinct things: *the place of the lines*, with the *general character* of the spectrum. I said that the spectrum of the star is like that of magnesium, for *the circumstance of giving brilliant lines on uniform ground*; but I never said that the brilliant lines are on the star, *at the place of the magnesium*. These two things are very different.

These explanations are necessary, because, according to the writer, "Spectrum Analysis," my article would appear a full set of nonsense.

Truly yours,

Rome: November 15, 1866. A. SECCHI.

A delightful volume of **Familiar Lectures on Scientific Subjects**, by Sir John Herschel, has just been published (Strahan). Amongst the subjects are—Volcanoes and Earthquakes, The Sun, Comets, The Weather and Weather Prophets, Light, &c.

THE PLANETS FOR JANUARY.

Mercury may be well seen at the beginning of January, rising more than one hour and a half before the Sun; this favourable position gradually decreases until the end of the month.

		h.	m.	s.			°	′		
1st	R.A.	17	12	39	Decl.	—	21	45½	Diameter	5″·8
15th	"	18	36	24	"		23	48	"	5″·0

Venus rises at half-past five in the morning on the 1st of the month, and earlier every day during January; she is therefore well fixed for observation.

1st	R.A.	16	43	55	Decl.	—	17	38½	Diameter	50″·8
15th	"	17	0	2	"		17	29½	"	40″·2

Illuminated portion of the disc of Venus, 0·252.

Mars now reigns supreme throughout the night, coming to opposition on the 10th of January. He is very near to β Geminorum at the beginning of the month.

1st	R.A.	7	46	34	Decl.	+	25	11½	Diameter	17″·4
15th	"	7	22	37	"		26	20	"	17″·2

Illuminated portion of the disc of Mars, 0·999.

Jupiter is rapidly passing from view, and is almost close to the Sun at the end of the month.

1st	R.A.	20	37	3	Decl.	—	19	11½	Diameter	31″·2
15th	"	20	50	13	"		18	21½	"	30″·8

Saturn may be observed in the mornings rising about four o'clock at the beginning, and about two o'clock at the end of the month.

1st	R.A.	15	16	58	Decl.	—	51	58½		
15th	"	15	21	41	"		16	14½	Diameter	14″·6

Dimensions of Ring—Outer Major Axis, 36″; Outer Minor Axis, 14″.

Uranus continues well placed for observation in the evenings.

5th	R.A.	6	26	26	Decl.	+	23	38	Diameter	4″·2
17th	"	6	24	17	"		23	39½	"	4″·2

Neptune passes the meridian about five minutes before six in the evening on the 1st of the month, and is gradually getting unfavourably placed for observation.

5th	R.A.	0	39	35	Decl.	+	2	33½
17th	"	0	40	6	"		2	37½

The Minor Planet **Astræa** arrives at opposition this month.

5th	R.A.	8	28	44	Decl.	+	14	51
17th	"	8	19	10	"		15	58

N.B.—The Supplement to the *Nautical Almanac*, with the positions of the newly-discovered Minor Planets, has been discontinued.

NEW MINOR PLANETS.—I beg to forward to you, for the benefit of the readers of the *Astronomical Register*, the following positions of the last two new planets discovered at the Bilk and Marseilles Observatories respectively.

Yours very truly,

Upper Clapton: Dec. 11, 1866.

JOHN PARNELL.

					h.	m.	s.		°	′	″
Planet	90.	Oct. 2,	1866.	R.A.	0	8	42	Decl.	S. 2	35	42
"	91.	Nov. 23,	"	"	1	32	9	"	N. 11	58	14

ASTRONOMICAL OCCURRENCES FOR JAN. 1867.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Uranus
Tues	1		Sidereal Time at Mean Noon, 18 42 40 6			11 42·5
Wed	2	17 38	Conjunction of Moon and Venus, 0° 4′ S.			11 38·4
Thur	3	14 7	Conjunction of Moon and Mercury, 4° 8′ S.			11 34·2
Fri	4		Meridian passage of the Sun, 5m. 8s. after Mean Noon	1st Oc. D. 2nd Tr. E.	4 49 5 17	11 30·1
Sat	5	12 30	● New Moon	1st Tr. E. „ Sh. E.	4 23 4 54	11 26·0
Sun	6		Declination of Uranus, +23° 38½′			11 21·9
Mon	7	11 42	Conjunction of Moon and Jupiter, 4° 25′ S.			11 17·8
Tues	8	4 4 5 2	Occultation of 18 Aquarii (6) Reappearance of ditto			11 13·6
Wed	9	6 2 7 10	Occultation of B.A.C. 7774 (6) Reappearance of ditto			11 9·5
Thur	10	10 17	Opposition of Mars			11 5·4
Fri	11					Moon. 4 23·4
Sat	12					5 11·5
Sun	13	4 34	☽ Moon's First Quarter			6 1·2
Mon	14					6 53·3
Tues	15					7 48·4

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon. —
Wed	16		Sidereal Time at Mean Noon, 19 41 49·0.			8 46·4
		4 1	Occultation of θ^1 Tauri (4½)			
		4 39	Reappearance of ditto			
		4 4	Occultation of 75 Tauri (6)			
		4 50	Reappearance of ditto			
		4 21	Near approach of Moon to θ^2 Tauri (4½)			
		4 47	Occultation of B.A.C. 1391 (5)			
		5 48	Reappearance of ditto			
		7 26	Occultation of *Aldebaran* (1)			
		8 37	Reappearance of ditto			
Thur	17	11 59	Occultation of 130 Tauri (6)			9 46·8
		13 6	Reappearance of ditto			
Fri	18	4 49	Conjunction of Moon and Uranus, 5° 19′ N.			10 48·3
		7 44	Occultation of 26 Geminorum (5½)			
		8 48	Reappearance of ditto			
Sat	19	0 42	Conjunction of Moon and Mars, 8° 57′ N.			11 49·0
		13 47	Occultation of 1 Cancri (6)			
		14 44	Reappearance of ditto			
		19 36	○ Full Moon			
Sun	20		Declination of Mars + 26° 36½′			Mars — 11 14·3
Mon	21	15 22	Occultation of B.A.C. 3398 (6)			11 8·8
		15 39	Reappearance of ditto			
Tues	22					11 3·4
Wed	23					10 58·0
Thur	24					10 52·7
Fri	25					10 47·4
Sat	26		Meridian passage of the Sun, 12m. 47s. after Mean Noon			10 42·1
Sun	27	2 47	☾ Moon's Last Quarter			10 36·9
Mon	28	9 32	Conjunction of Moon and Saturn, 2° 14′ S.			10 31·8
Tues	29	19 10	Near approach of Moon to B.A.C. 5379 (5)			10 26·7
Wed	30					10 21·6
Thur	31	6 12	Conjunction of Moon and Venus, 0° 29′ S.			10 16·6

POLAR REGIONS OF THE MOON.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—During a great portion of the year 1867 the Moon will depart to the greatest extent from the state of mean libration; for when her libration in longitude vanishes, her libration in latitude will be near its maximum. This will afford excellent opportunities not only for viewing her polar regions, but also for determining points of the first order, which are greatly wanted in those regions. Undermentioned are the dates when her N. and S. poles will be fully in view, with her latitude and age, a notification of which in the *Register* will oblige

Yours very truly,
W. R. BIRT.

42 Sewardstone Road West, Victoria Park,
London, N.E.: Oct. 23, 1866.

Days on which the N. pole may be seen:—

	Date	Lat.	Age
1867	Jan. 18	4°54′ S.	12·5
	Feb. 14	5 7 S.	9·7
	Mar. 12	5 15 S.	6·1

On these days the Moon will be in Perigee.

Days on which the S. pole may be seen:—

	Date	Lat.	Age
1867	June 17	4°47′ N.	14·9
	July 14	4 53 N.	12·6
	Aug. 10	5 3 N.	10·3
	Sept. 7	4 53 N.	9·0
	Oct. 5	4 30 N.	7·5
	Nov. 2	3 53 N.	6·0

On these days the Moon will be in Apogee.

On March 26, April 23, and May 20, *after the full*, the S. pole may be seen more favourably than on the above-mentioned dates.

THE NOVEMBER METEORS.—Lieut. G. L. Tupman determined the radiant point of the late meteoric shower to be R.A. 11h. 23m.; Dec. N. 18½°. Herr Schmidt found the maximum at 14h. 15m. mean time at Athens, and the horary number for one observer to be 1,055.

BRIEF CORRESPONDENCE.

I thank your correspondents W. L. Banks and G. J. W. for their information; but they do not tell me whether the Eclipse of 1887 is total anywhere in Great Britain, nor of the next total Eclipse that can be *conveniently* seen. Will you also tell me of the best Almanac for amateurs, for 1867, containing a list of occultations, the price of the Almanac, &c.? CURIOSUS.

I shall be obliged if I can be informed, through the medium of the *Astronomical Register*, the exact declination of the magnetic needle, from true North, for the latitude of 53° N. Any further information in reference to the subject will oblige yours, &c., POLARIS.

What is the best Guide to use in order to find and identify the most interesting celestial objects of small magnitude with a 3¾-inch achromatic, or 6½-inch Newtonian reflector, both mounted non-equatorially? Also, Is it probable that another edition of the "Cycle of Celestial Objects" will be published soon? and, if not, where can I procure a copy? W. S.

Could any one of your esteemed correspondents inform me where I will find plain instructions for the permanent fixing of an equatorial stand, or directions for the correct occasional placing of a portable equatorial?

AMATEUR.

About how soon is the forthcoming new issue of the Rev. T. W. Webb's *Celestial Objects* expected to be ready? Have the publishers secured permission to adorn this edition with the author's portrait? It is surely unnecessary to point out how much the value of the work would be thereby enhanced in the eyes of the astronomical world, where he has been so long known and so much beloved. G. T. F.

Can any of your readers inform me who is the publisher of a pamphlet, by Mr. J. M. Lockyer, entitled *Observations on the Planet Mars*, published, I think, in 1863; also, whether it is illustrated; and the price?

W. G.

I regret to observe the tone of *flippancy*—to use no better word—which occasionally prevails in describing and treating of scientific subjects. I have noticed it much in regard to the late meteoric shower. For the general public, or for cheap newspapers and comic periodicals, it may be in keeping to use the terms "fireworks," "sky-rocket dances," &c.; but surely such expressions should not be employed in scientific periodicals, nor used to create a laugh at scientific meetings. C.

Probably either "The Heavens," by Guillemin, translated by Lockyer, or Chambers's "Handbook of Astronomy," would meet the wishes of J. C. (*Ast. Reg.* Vol. iv. p. 295.) New editions of both these valuable works—the latter the more portable—are announced. It would be acceptable, no doubt, to many, if Mr. Chambers were to give us, at the end of every year, a brief resumé of Astronomical progress and discovery. G. J. W.

In answer to "Amateur," I have some indistinct recollection that Fergusson treats a little of Orreries in his "Astronomy." G. J. W.

INSTRUMENTS, &c. FOR SALE.

These Notices, which are restricted to *two lines* each, are inserted free of charge to subscribers: applications respecting prices and other particulars to be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—For Advertisements with prices and more complete details, a small charge will be made.

N.B.—It is particularly requested that we may be informed when instruments are disposed of, in order that the notice may be withdrawn, and fruitless applications prevented.

Achromatic Refractor, 6·4 in. ap. 8½ ft. focus, by *Merz*, Equatorial and clockwork by *Troughton & Simms.* [73]

Achromatic Refractor, 4 in. ap. 5 ft. focus, by *Dollond;* equatorially mounted. Powers up to 400. [87]

Dialyte Telescope, 4¼ in. ap. 5 ft. focus, price very low. [88]

Gregorian Reflector, 4¾ in. ap. 2 ft. focus, by *Dollond*, 4 powers, 50 to 200, finder, &c., on brass table stand. [63]

Achromatic Object-Glass, 4⅛ in. ap. 62 in. focus, by *Slugg*, with brass cap and receiving cell, for mounting on tube. [85]

Newtonian Metal Speculum, 8 in. ap. first-class quality. [77]

Transit Instrument, 3¾ in. ap. 5 ft. focus, Ys fitted with agates for mounting on stone piers. [29]

Equatorial Stand, for a 5 or 6 ft. telescope: 13 in. circles, divided on silver, to 10″ of space and 4s. of time.—Has never been used. [55]

Varley Stand, improved, rackwork movements, for a telescope of 5 or 6 ft. focus: on circular turn-table, to point in any direction. [16]

Polar Axis, of mahogany, 7 ft. long, adapted for a 4 ft. telescope, with 12 in. circles, reading to minutes. [56]

Speculum Grinding Apparatus, capable of working a 7 ft. speculum: with tube and fittings for a 9 in. Newtonian. [57]

Electrical Machine, powerful, 18 inch ebonite plate, by *Silver & Co.*, with brass conductor. [93]

Electrical Machine, plate 12 inches in diameter, in case complete. Price low. [90]

Recreative Science: and the first three volumes of the **Photographic Journal:** price very low. [30]

INSTRUMENTS, &c. WANTED.

Equatorial Telescope, about 6 in. aperture, with driving clock and circles; price moderate. [89]

Astronomical Clock, not very first-class; price low. [65]

Equatorial Stand, for a 5 ft. Refractor: graduated circles. [35]

Transit Instrument, 2 in. ap. 18 or 24 in. focus. [71]

Monthly Notices of the Royal Astronomical Society, Vol. 3. [26]

Monthly Notices: Vols. 3, 4, 5, and 7. [82]

Bartholomew Prescot on the **Universe,** published 1823: a copy wanted, in good condition. [84]

LIST OF SUBSCRIBERS—Names received since our last number.

Bayley, W. H., Esq., 25 Cambridge Square, Hyde Park.
Browning, J., Esq., 111 Minories, E.C.
Coates, J. S., Esq., Flounder's College, Ackworth, near Pontefract.
Garnett, W., Esq., Bashall Lodge, Clitheroe.
Gooch, Miss, Torquay.
Vanner, W., Esq., Chemical Works, New Road, Battersea Park.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

December 1866.
Kincaid, S. B.
Webb, Rev. T. W.

To March 1867.
Glover, E.
Petty, T.
Wolley, Rev. J.

To June 1867.
Hubbersty, Rev. R. C.
Noble, W.
Tupman, G. L.
Gooch, Miss.

To December 1867.
Bayley, W. H.
Ellis, W. M.

Hall, Rev. R.
Jones, Rev. E.
Smyth, Prof. C. P.
Williams, G.

To June 1868.
Finch, A.

To December 1868.
Banks, R. R.

Dec. 22.

NOTICES TO CORRESPONDENTS.

C. Grover.—Our Correspondent need not fear that we shall occupy the pages of the *Register* with anything of the character alluded to in his note.

Communications from J. N. L.—A. W. D.—D. A. F.—A Subscriber—and some others are in type, but deferred for want of space.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Stamford Villa, Downs Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 50. FEBRUARY. 1867.

ROYAL ASTRONOMICAL SOCIETY.

Third Meeting, January 11, 1867.

The Rev. C. Pritchard, M.A., F.R.S., *President*, in the chair.

Secretaries—Mr. Hodgson and Mr. Stone.

The minutes of the last meeting were read and confirmed. Numerous presents were announced, and the thanks of the society voted to the respective donors.

E. W. Brayley, Esq., F.R.S.	The Rev. Jas. Parkes,
R. Cooke, Esq.	W. Osborne, Esq., and
B. Löewy, Esq.	Thomas Warren, Esq.,

were balloted for and duly elected Fellows of the Society.

The following papers were read (in some cases the titles only being given):—

On the Luminous Meteors of November 13th: by Professor Challis.

The author made his observations at Cambridge, in company with Professor Adams and Mr. Todd, assistant at the Observatory. They were stationed on the flat roof of a building allowing an almost uninterrupted view of the heavens. Professor Challis had devised a wooden instrument he called a meteoroscope, which had a moveable arm capable of being pointed to the meteors or stars, and having its indications read off afterwards. The two professors made observations with this, and Mr. Todd gave out the time. By this arrangement the places of 63 meteors and 7 stars of comparison were recorded between 11h. 30m. and 14h. 15m., which, with the G.M.T., had been sent to Mr. Glaisher. At 13h. 20m. he saw a stationary meteor expire and afterwards rekindle. He pointed the meteoroscope at it, and subsequently at Regulus for its place. Professor Challis deduced the radiant point from his observations, which came out R.A. 148° 29′, and

N.D. 22° 47′. As to general appearance of the meteors—the trains were mostly blue and green, and the heads ruddy in colour. There was a glow perceptible in the heavens like an aurora; but Mr. Glaisher informed him that the magnets were remarkably quiet.

Professor Adams stated (in answer to the President) that his determination of the radiant point differed slightly from that just mentioned—viz., about a degree in R.A., and half a degree in N.P.D.—and that it was rather nearer to the average point of other observers than his own.

The President: At the last meeting I expressed a hope that when you had the determinations of a number of other observers, you would recompute the radiant point, including the others with your own, and giving them their proper weights.

Professor Adams: I shall be happy to do so when I obtain the materials.

On the November Meteors: by Mr. E. J. Lowe, of Highfield, Notts.

It was close upon midnight before the meteors became very numerous, although fine ones had been seen earlier. At the radiant point they blazed out and died away; when near it they had short trains, and but few fell towards the NE. of the radiant point. One left a disconnected train, which faded gradually at both ends; one passed near the horizon; and one appeared to burst very near the observer, while two minutes afterwards a noise was heard which was certainly not terrestrial.

On the Meteors observed at Mr. Barclay's Observatory, Leyton: by Mr. Talmage.

On the November Meteors: by Mr. Taunton.

On the same subject: by Mr. G. W. Maclear.

The author is second assistant at the Cape Observatory, and gave the result of the observations made there by himself and others on the Observatory roof. The display commenced at 13h. 3m., starting up from near Regulus as Leo rose—three, four, and seven appearing at once. The nuclei were often orange, with green trains; others were without trains. At the early part of the time they seemed about the 5th magnitude, but when the radiant point got near the zenith they became like 1st magnitude stars, and often much finer. Between 14h. 10m. and 14h. 13m. 200 were counted. One to the south of Regulus, at about 14h. threw off flashes of light like liquid fire. The observations ceased at 16h. 21m., when it became day. Between 13h. 15m. and 16h. 21m. 2,742 were counted, the majority starting from between Regulus and η Leonis.

On a Bright Meteor: by Mr. Hodgson.

This paper recorded the number of meteors counted by the author, and stated that after the shower had subsided, at 15h. 6m., a meteor, having a brilliant train and a nucleus like Jupiter, burst very near his house; and as this was not seen by the Greenwich observers, who were about seven miles due south, he thought it must have been within half a mile of him.

Mr. De la Rue: At 3h. 5m. 58s. I noted a very fine meteor, which burst near η Bootis.

Mr. Hodgson: That will not do; mine was under Ursa Major.

Captain Noble: The parallax would be enormous.

On the Spectra of the Meteors seen on 13th November: by Mr. Browning.

The author made his observations at Upper Holloway, where he could see the radiant point rise above the horizon free from the confusion caused by the lamps of London—a matter he thought very important in spectroscope observations. The instrument used was the direct-vision prism invented by Mr. Alexander Herschel, no other being of any use.

The President: Mr. Herschel has stated that he saw the line D with such a prism.

Mr. Browning used a pair of such prisms, and showed a diagram of the coloured spectra he observed. In those of the nuclei, which were of the type of ordinary light, all the colours but violet were seen; but the yellow preponderated, occupying sometimes half the breadth of the spectrum, instead of an eighth—a fact which Mr. B considers quite sufficient to indicate the presence of sodium; as chemists, when they saw the yellow colour produced in a blowpipe flame by a mineral, at once admitted the existence of that metal in the specimen. In six or eight meteors the nucleus gave a yellow line only, which he thought nothing but sodium could produce; and in two the resulting line was a bright green only, like that of thallium. The light from the trains, when green, appeared continuous in the prisms; and blue trains gave a line of lavender, with occasional traces of a continuous spectrum.

Mr. Stone: As these spectra were only seen for an instant, might not the eye be attracted by the yellow light, being the strongest, more than by others, and thus an undue importance be given to it?

Mr. De la Rue: The absence of a slit in the spectroscope produces broad bands of colours. Mr. Browning is quite right as to the inference regarding soda which a chemist would draw from the yellow flame seen in blowpipe experiments.

The President: Then we may take it that without a slit the accuracy of the spectroscope does not exceed that of a blowpipe examination of a substance?

Mr. Browning: Not exactly: in the spectra of trains we get distinct lines. Mr. Alexander Herschel, who saw the yellow line in August, thinks the August and November meteors are specifically different.

Mr. Lockyer: Do you mean by *lines*, dark lines, or bands of colour?

Mr. Browning: I mean *bright* lines on a luminous spectrum.

Mr. Lockyer: As I understand spectrum analysis, if the nucleus of a meteor were incandescent vapour we should get bright lines, and a train of the same kind would give similar lines; but a mass of solid incandescent matter would give a continuous spectrum, and if surrounded by vapour would be crossed by dark lines. At present we have no evidence of any such dark lines.

Mr. Browning: None have yet been seen, but I think they will be. I am in hopes by next November we shall be able to make the spectra appear perfectly still.

Mr. Lockyer: You saw only bright lines, or bright lines on a continuous spectrum; in fact, the light was homogeneous.

Mr. Browning: All the trains were homogeneous.

Captain Noble wished to ask Mr. Hodgson whether he heard any sound when a meteor burst apparently so near. In his own case, under the most favourable circumstances for detecting sound, not the slightest noise was audible.

Mr. Hodgson heard no sound from any of the meteors. He reported the particular one as likely to be near him from the absence of any corresponding observation at Greenwich, where an observer looking northward must have seen it.

Occultations of Stars by the Moon, and Phenomena of Jupiter's Satellites observed at Greenwich: by the Astronomer Royal.

The Secretary stated that Mr. Airy remarked at the occultation of Aldebaran, the star did not come out bright instantaneously, but was thirty-eight seconds regaining its full light; whereas Mr. Joynson, who had also seen the occultation, described the star as sliding on to the Moon's disc at the immersion, but reappearing instantaneously.

On the Telescopic Discs of Stars: by Mr. Knott.

The author uses a telescope of 7½ inches aperture, made by Alvan Clarke, having a focal length of 110 inches, charged with an eye-piece giving a power of 368. He applied the micrometer to measure the discs of stars produced by diminishing the aperture, and found that between the full size and 4 inches the proportions were as 760 to 948, the disc increasing as the aperture diminished. This proportion was observed very nearly with all stars; but with less aperture the discs increased in excess of this ratio, amounting with 2 inches only to three times the size given by the full aperture. Thus *α* Coronæ Borealis measured $0''{\cdot}833$ and $2''{\cdot}124$ with the respective apertures.

The President: Does Mr. Knott affirm that the disc depends upon focal length and aperture?

Mr. Hodgson: Yes, we are all agreed upon that.

The President and Mr. Stone both said focal length did not influence the size of the star discs.

Mr. Stone: This paper was communicated to me, and only takes the size of the aperture into account, and shows that the measures agree pretty well with theory, the size increasing inversely as the aperture diminishes.

The President: Mr. Dawes will send a paper shortly on this subject. The undulatory theory of light is on its trial as to this matter; and Mr. Dawes will prove that recent experimental results are entirely accordant with the mathematical ones.

Further Remarks on the Use of an Eye-piece Prism in Measuring the Angle of Position in Double Stars: by Mr. Dawes.

In his former paper the author adverted to the objection raised by Mr. Otto Struve, that the prism might introduce errors; and Mr. D. now wished to state that he did not recommend its use in all cases, but only when a slight inclination of the head would not suffice to bring the stars to the vertical.

On ζ Herculis: by Mr. Dawes.

Having heard from Mr. Alvan Clarke that the comes had reappeared, Mr. Dawes made measures last September, and found the distance exceeded a second, his last result being 1″·017.

The President pointed out that some of Mr. Dawes' measures were taken at noonday, and said that, although nearly or quite 70, Mr. D. could still distinguish the companion of Polaris with 1·6 inch of aperture, justifying his opinion that his sight was unimpaired.

On an Ancient Eclipse of the Sun observed in India: by Mr. Peacock.

Observations of the Total Eclipse of the Moon, Sept. 24, 1866, *at Windsor, N. S. Wales*: by Mr. Tebbutt.

On the Correction of the Secondary Spectrum in Achromatic Object-Glasses: by Mr. Wray.

The author stated that, after extensive experiments on the residual spectrum, he had succeeded in removing all traces of chromatic aberration, and this was done by simple and inexpensive means. The subject had occupied his attention since 1855; and so long as he confined himself to the ordinary materials, the irrationality remained. He could free glasses entirely from primary aberration; but when he tried to combine lenses into triple or fourfold combinations, he found glass, although he included Faraday's heavy borate of lead glass among his materials, hopeless. By means of well-selected flint and crown glass, and the intervention of a highly dispersive cement, he had not only corrected but could reverse the secondary spectrum. He had made several object-glasses of from 4 to 7 inches aperture with complete success. The effect of the improvement on the Moon was very great, and even more upon Jupiter, where the belts and shadows were much better seen from the absence of chromatic confusion. Mr. Airy had undertaken to examine a 7-inch glass of 8½ feet focal length.

The President: Assuming the statements in the paper to be well founded, a great step has been gained in the construction of telescopes; but the whole thing admits of great discussion, and truth never loses by discussion. As we must pass on to-night to the special business, I will only now ask Mr. Stone whether he knows anything of the object-glass sent to Greenwich?

Mr. Buckingham: The telescope is not there yet, but will probably be in a few days. I have seen through it and a dozen others; and with the 7-inch one, and a power of 2000, have seen stars absolutely free from colour.

The President: Large ones?

Mr. Hodgson: Such as α Lyræ?

Mr. Buckingham: I have seen Capella with that power. Mr. Wray is now making a 10-inch object-glass.

Col. Strange: Is anything known about the cement? It should be permanent, and not at all liable to decompose.

Mr. Buckingham: It is no secret; the invention is patented. You may use Canada balsam, or balsam and castor-oil, and many other substances.

Col. Strange: Canada balsam will not do in India. This has been tried.

The President: If this paper be printed without further discussion—which time will not permit—and it afterwards turns out the process does not answer, the Society must not be considered responsible for what has been stated.

Mr. Hodgson: Was Capella also free from rings?

Mr. Buckingham: Certainly not.

Mr. Hodgson: What colour were the rings?

Mr. Buckingham: I am not prepared to say.

Comparison of Sun-spot Observations at Kew in 1866 *with those of Schwabe*: by Messrs. De la Rue, Balfour Stewart, and Löewy.

On the Solar Eclipse of August 1868: by Major Tennant.

On the Disappearance of the Lunar Crater Linné: by Mr. Birt.

Mr. De la Rue inquired whether there were any very old exact observations of Linnæus, as he was very much inclined to doubt that any change had taken place?

Mr. Birt replied that the crater was first found in Riccioli's map, dated 1613.

The President: What optical means had he?

Mr. Birt: That is not exactly known, but the class of instruments then used is; and the resulting map includes the crater. Linnæus is not in Schroter's chart, but the place is occupied by a dark spot. The crater is not found in Russell's maps, but is drawn and described by Lohrmann, who says it is very deep. Schmidt, who has been familiar with the mountain since 1841, says he always saw it without difficulty until the close of last year.

The meeting was then made special, and, after much discussion, certain bye-laws were suspended in order to enable the Council to award the medal to Mr. Huggins and Dr. William Allen Miller jointly, for their researches on Spectrum Analysis applied to the heavenly bodies; and the Society then adjourned.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

THE LUNAR CRATER "LINNÉ."

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—During the Lunation—1866 December 6, to 1867 January 5—the observations that have come to hand are destitute of any notice of the crater Linné—that is to say, while a white spot *larger* than Linné has been observed in its place, neither the *interior* nor the *margin* of the crater has been detected. Taking the epoch of Schmidt's observation October 1866, when he lost the crater, it may be interesting to inquire as to its previous history and also its present state. The first of the following tables embodies all the previous records, so far as I know; and the second gives the measures I obtained during December:—

Date	Authority	Brightness
1653	Riccioli	0
1788 Nov. 5	Schröter	0·5
1823 May 28	Lohrmann	7·0 +
1831 Dec. 12, 13	Beer and Mädler	6·0
1858 Feb. 22	De la Rue	5·0
1865 Oct. 4	De la Rue	5·0
	Rutherford	6·0

The last three determinations of brightness are from photographs. There is some uncertainty in determining this element on the prints. Mr. Buckingham took a series of photographs in November, in most of which the place of Linné appears, although it is but faint. Schröter, in t. ix. of his *Selenotopographische Fragmente*, gives a large dark spot in the place of

Linné; and the Rev. T. W. Webb informs me that Linné is not to be found on Russell's globe and maps (1797), from which it may be inferred that the crater has previously been obscured.

When Linné came into sunlight about December 13, 1866, it was only by means of large apertures that its place could be detected. Mr. Talmage, with Mr. Gurney Barclay's 10-inch refractor (see *antè*, p. 12), and the Rev. T. W. Webb, with his 9¼-inch silvered glass reflector, saw only a whitish ill-defined spot in the place of Linné. With smaller apertures no trace could be seen. Should the sky be clear, the evening of February 10, 1867, will afford an opportunity of looking for Linné under similar illuminating circumstances as on December 13, 1866. From December 14 until the 21st inclusive, the spot in the place of Linné appeared of variable size, but became *smaller* and *brighter* as the illumination advanced. The following table gives the measures and brightnesses:—

Date	Dionysius	Linné	Mag.	Miles	Brightness
1866	″	″			°
Dec. 15	14·70	11·61	0·79	10·9	4
„ 18	14·13	7·07	0·50	6·9	5·5
„ 19	13·95	7·32	0·52	7·2	5
„ 21	13·32	6·75	0·51	7·0	4

The numbers in column four headed "Mag." are obtained by dividing the measures of Linné by the measures of the standard spot "Dionysius." The normal magnitude of Linné is 0·40 (Dionysius being unity), as determined by two independent methods. That the numbers in column five, headed "Miles," are really greater than the extent of Linné, is evident when we consider that the true size of a lunar crater exceeds its apparent size in the proportion of the secant of its angular distance from the moon's centre. These numbers are not absolute but only relative as compared with Dionysius by means of the numbers in column four. Dionysius according to Lohrmann is 13·8 English miles; and Linné, according to Schmidt, 5·6 English miles in diameter.

On the evening of December 21, 1866, Linné appeared almost similar to the mountain γ of B. and M. on the SE. of Posidonius, but slightly exceeding it in size; the measure of γ was 6″·37.

I am, Sir, your obedient servant,

42 Sewardstone Road West, Victoria Park, W. R. BIRT.
London: January 5, 1867.

Sir,—The obliteration of the crater Linné is now an unquestionable fact, and its discovery does the greatest credit to the close and patient observations of Dr. Schmidt, of Athens. It constitutes, I believe, the first well-established instance of change on the lunar surface observed by man; and gives us good hopes of acquiring by-and-bye more certain knowledge of the present condition of our satellite. Whether the phenomenon be a mere obscuration of the crater from temporary causes, or whether it be a more substantial change in the crater itself, time alone can tell us; but in the meanwhile I may be permitted to place on record my impression that the latter is more likely to be the case.

On Saturday last, January 12, at 5.15 P.M., I examined the spot, for the first time since I had heard of the phenomenon from Mr. Birt, with my silvered glass Newtonian, 12 inches aperture. The air was very tremulous (the temperature had fallen to 22°), but still definition was fairly sharp with powers of 250 and 300. At first sight the appearance was certainly that of a whitish cloud obscuring the crater; but upon long gazing, and using averted vision, I could plainly make out a *centre* or *nucleus*, and presently afterwards a *marginal ring* of perhaps twice the diameter of the original Linné. Of this last appearance I do not speak so positively as I do of the former, though I have but little doubt about it in my own mind.

My impression is that the crater has been actually filled in, and that the ejected matter has been sufficient to form a slightly raised ring at some distance from the centre (such as we have many instances of in other parts of the lunar surface), and in the final effort has formed a slightly raised central cone.

Of the visibility of a central spot on Saturday last I have no doubt whatever; if, therefore, the crater is merely obscured by something of the nature of cloud, we might infer that an eruptive action is now going on. But while gazing at the object I could not bring myself to believe that anything of the nature of cloud covered the real lunar surface.

To form, however, anything like a satisfactory opinion about the matter, we must wait for a lunation, when the terminator may be seen closer to Linné than it was on Saturday last.

Yesterday, at the same hour, under a higher illumination, the central spot was barely visible by glimpses.

I am, Sir, your obedient servant,
HENRY COOPER KEY.

Stretton Rectory, Hereford:
Jan. 14, 1867.

Sir,—In connection with the remarkable obscuration of the lunar crater Linné, noticed in the first instance by Herr Schmidt, Director of the Observatory at Athens, in October last, to which attention is called by Mr. Birt in the January number of the *Register*, the following recent observations made with my 7½-inch Alvan Clark refractor may not be uninteresting to some of your readers.

My attention was first called to this object by a circular from Mr. Birt; and on the 19th of December last I observed Linné as an ill-defined bright patch with soft edges, very similar in brightness and general appearance to a mountain on the Mare Serenitatis, east of Posidonius, marked γ on Beer and Mädler's large map. The atmospheric circumstances were not, however, sufficiently favourable for precise observation.

On the evening of the 12th instant I again observed Linné under more favourable circumstances. The crater was not far from the terminator, the Mare Serenitatis being complete, and the sun just rising on the western walls of Aristillus and Autolycus. Between 6h. 40m. and 7h. 15m. G.M.T. I made the following observations, which I quote from my journal:—

"I see clearly the '*ghost*' of the ring of Linné. It is more conspicuous, broader (and brighter?) on the western side. The shading in the interior is of about equal intensity with that of the surrounding surface of the Mare Serenitatis. I do not see any real interior or exterior shadow, though the shadows in neighbouring craters, even those of very small dimensions, are very distinct. The ring or wall of the crater has a slightly nebulous appearance, and its brightness is barely equal to that of the mountain east of Posidonius, marked on Beer and Mädler's large map. Its diameter is to my eye larger than than of Sulpicius Gallus."

Last evening, January 14th, I again observed Linné, when it presented much the same appearance as on the 19th December—viz., a bright, ill-defined patch, very similar in appearance to Beer and Mädler's γ referred to before. On this occasion the atmosphere was rather disturbed, but small craters in the immediate neighbourhood showed interior shadows.

I am, Sir, yours faithfully,
Woodcroft Observatory, Cuckfield: GEORGE KNOTT.
January 15, 1867.

STELLAR SPECTROMETRY.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The substance of the remarks I made at the Astronomical Society respecting the spectra of the November meteors are not quite correctly reported in the last number of the *Astronomical Register*.

Instead of saying that "in one spectrum I saw one line in the yellow and two in the green," I stated that I had not been able to detect any bright lines in the spectra, but that several spectra had the appearance of only a single line of yellow light, and two of the spectra gave the appearance of only a single line of green light. The inference, of course, is that the light of these spectra was homogeneous. These remarks had reference only to the spectra of the *nuclei*.

With regard to the spectra of the *trains*, I stated that none of the trains I observed presented any characteristic appearances; that they gave lines of light of the same colour as they presented when seen by the naked eye, when viewed through the prisms.

Feeling sure that you will kindly insert this explanation,

I am, your obliged subscriber,
Upper Holloway: JOHN BROWNING.
Jan. 12, 1867.

Sir,—In the spectrum of γ Cassiopeiæ, in addition to the bright line in the blue-green observed by Father Secchi (*Astronomical Register*, No. 46, p. 225), there is a bright line in the red.

Micrometrical measures of these bright lines show that they are doubtless coincident in position in the spectrum with Fraunhofer's C and F, and with two of the bright lines of luminous hydrogen.

I am, your obedient servant,
Upper Tulse Hill. WILLIAM HUGGINS.

Sir,—The letter of P. Secchi in your last number proves that my remarks in November, on his paper, have at least produced the good effect of eliciting an authoritative correction of the error I suspected as to the phrase white *lines*, when *stars* were meant.

On the other points referred to you will perhaps allow me to say a few words. So far as any confusion of things is concerned, I really think it arises from the wording of the original paper, and not from my observations thereon. I did not confuse "two very distinct things,"—"*the place of the lines* with the *general character* of the spectrum;" because P. Secchi writes of the star γ Cassiopeiæ "its spectrum appears that of magnesium," which, to every person acquainted with the subject, would at once indicate identity of *place of the lines*, and not simply *bright lines*, instead of *dark*, which would have been properly expressed by writing that the spectrum *appears* *like that of burning metals.* Why should magnesium be specially named, when the general character of all metals was only intended, unless some of the distinguishing lines of that substance were referred to? It is true the author proceeds to say there are differences; but any impartial reader would still suppose some of the characteristic magnesium lines were present, or that metal would not have been singled out as the type of the spectrum. My apparent contradiction in lines 13 and 27 (ascending) is not a real one. Mr. Huggins had seen the appearance described by Secchi, and even another band of the same kind; but he hesitated to assert it was due to an incandescent gas or metal, and therefore the inference which formed a part of the original observation still required to be "verified." Of the perfect independence and great value of Secchi's researches there can be no doubt.

I am unable to say what are the relative dispersive powers of the instruments used by Mr. Huggins as compared with the details given by Secchi of his spectroscope; but the absence of a slit would, I think, be considered by all observers here to render observations of stellar spectra open to the deceptive effect I pointed out.

In conclusion, allow me to say that I have the highest respect for P. Secchi's contributions to astronomy, and rejoice to see his observations recorded in your pages. Long may he be spared to contribute, as he has hitherto done, most valuable observations in nearly all departments of astronomical science, and last, but not least, in

Jan. 5, 1867. SPECTRUM ANALYSIS.

THE PLANET MARS—RADIANT POINT OF STAR-SHOWERS—TRISECTION OF AN ANGLE.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I partly suspected that the introduction of a new estimate of Mars' diameter led to the discrepancy in the semi-diameters assigned for 1864 and 1867. I was unable to verify the supposition, having by me only extracts I had taken from Nautical Almanacs in the British Museum. But I had a fair reason for speaking of want of care in the construction of certain columns of the Nautical Almanac, as the following little table of extracts (taken at random) will show:—

1866	Hor. Parallax of Mars.	Apparent Diameter of Mars.
	"	"
Jan. 1	3·5	3·5
Feb. 25	3·8	4·2
April 19	4·2	4·9
June 25	5·1	6·5
Sept. 25	7·0	9·1

I need hardly say that the apparent diameter should be proportional to the horizontal parallax, whereas the above five diameters show a continually varying proportion. The resulting real diameters would be 3960, 4310, 4620, 4950, and 5150 miles respectively.

I do not quite understand why Mr Barkas (whose letter is exceedingly interesting) should find the radiation of meteors from a fixed point on the celestial sphere hard to reconcile with the zone-theory. The phenomenon of radiant points is, indeed, the main argument in favour of the cosmical origin of star-showers. If we remember that on the zone-theory the visible portions of the paths of shooting stars are (appreciably) parts of a system of parallel lines, we can see that these lines produced backwards (or forwards) must have a vanishing point in space, and also that the number of stars appearing very near the vanishing point must be few in number. Imagine, for instance, some thousand ropes, parallel and straight, and so arranged that the distances between neighbouring ropes should be tolerably uniform (say about a yard), the whole set forming a cylindrical system. Now if, along each rope, one part some yards in length were painted white, these painted streaks being at varying parts of the lengths of different ropes, it is easy to see that to an eye placed near the middle of the system, the painted streaks would appear as a series of lines converging towards the vanishing point of the set of ropes; and also that the space near this vanishing point would be comparatively clear of streaks.

E. J. is mistaken in supposing that the mathematical trisection of an arc or angle is impossible; it is the trisection by means of the line and circle that has (and must) foil the mathematician. By means of the hyperbola (a curve which can be traced out with a string and a revolving ruler) an angle can be readily trisected; there is also an easily traced curve called the *trisectrix*, from its affording the means of trisecting an arc or angle. If such curves as the epicycloid were available (in the way employed in Method 1), all that would be necessary would be to make the arc roll on a straight line, to trisect the finite line thus determined; then, rolling the arc a second time over the line, the points of contact of the trisections would trisect the arc. If this method were esteemed mathematical, it would be easy to rectify and thence to square the circle. The method amounts to simple measurement. So if the formation and development of cones were available mathematical processes, we could complete the sector contained by our angle, form this sector into a cone, trisect the circumference of this cone's base, and develope the sector with its arc trisected. Each of the methods marked 2 and 3 involves a problem not soluble by the line and circle. If any of your readers like to work at insoluble problems, here are the two referred to:—

(1) "Let A M, A N be two straight lines given in position, O a given point, K L a straight line given in length; required to draw a line P Q equal to K L, having its extremities on A M, A N (one on each), and so situated that the perpendicular on P Q from O may bisect P Q."

(2) "A B C D is a semicircle, A D its bounding diameter. From a given point B draw B C L meeting A D produced, in L, so that C L may have a given length."

I am, Sir, yours faithfully,
Woolwich: Jan. 12th, 1867. RICH. A. PROCTOR.

PERFORMANCE OF OBJECT GLASSES.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I cannot find, as I supposed, in the pages of the *Astronomical Register*, any notice of the performance of the 8¼-in O.G. by Alvan Clark, on γ^2 Andromedæ; but the remarks of Mr. Knott (*A. R.* No. 34, p. 247) are to the point. He there says that his 7⅓ O.G. does not fairly separate it, but that an 8-in. aperture would show a real separation. My 5-in. O.G. by Cooke shows γ^2 Andromedæ elongated, and glimpses of the companion of δ Cygni, not steadily; but it is some consolation to be informed, on the best authority,* that the 8¼ O.G. by A. Clark does *not* show γ^2 Andromedæ triple, *nor δ Cygni double.*

Ought we not to have a standard arrangement of *magnitudes* of stars?

There appears to be some confusion in the different ways of estimating them. I see stars of the 15th magnitude, as given in Darby's "Astronomical Handbook." May I ask is that the limit for a 5-in. O.G.? and what would be the estimated magnitude of these stars according to Struve's and Dawes' method? Mars is seen by me with fully ⅙th of his diameter of a greenish-white colour. The dusky markings in the centre of the planet are not sufficiently distinct to be drawn well.

I am, Sir, yours, &c.,

December 1, 1866. A SUBSCRIBER.

THE NAUTICAL ALMANAC.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Your correspondent "Athleta" has asked one or two questions with respect to the meaning and use of certain parts of the *Nautical Almanac*; if I can do anything to remove his difficulties, I shall be very glad. I will begin with a reply to his third question, as it involves the answer to Question 1. He asks, "Why does the 'apparent R.A. at transit' differ from that 'at mean noon?'"

If he will refer to the *Almanac* for 1867, in the 2nd and 3rd columns of pages 252 to 300, he will find the R.A. and D. of the several planets for each day at *mean noon*; and in columns 2nd and 6th (or 3rd and 7th, as the case may be) of pages 304 to 325, he will find the R.A. and D. of the same for each day at the *moment when each planet passes the meridian of Greenwich.* As, therefore, the time is not the same in the two cases, so also it will be found there has been a corresponding change in the planet's place. Thus, to take an example:

On June 1st, the Ephemeris on page 291 gives the place of Saturn R.A. 15h. 10m. 12·12s., S.D. 15° 14′ 52·5″ *at noon*; but the same page tells us (5th column) that the meridian passage at Greenwich does not take place till 10h. 30·4m. afterwards, and in that time the planet will have changed its place by an angular distance amounting to nearly half the difference due in 24 hours. Now, its R.A. *at noon* on the following day is 15h. 9m. 55·96s.; we should therefore expect to find its R.A. at transit, June 1st, intermediate to these two values; and on referring to p. 320 (3rd column) we shall find this to be the case: viz. R.A. 15h. 10m. 5·02s. In other words, if the positions were noted on a celestial globe or chart, the place of the planet at half-past 10 o'clock at night on June the 1st must necessarily be intermediate to the places occupied by it at *noon* on that and the following day.

For use with the transit instrument, the declination at transit, from page 320 (continuing the same example), is necessary, corrected by the addition of 2·3″ for every hour of longitude W.; and also the exact time when the transit will take place, which is given for the meridian of Greenwich, on page 291, 5th column; and which also will need correction for any other meridian west of Greenwich, by adding the longitude of the place turned into time.

"Athleta" further asks, to what use can we put col. 4., "Logarithm of true distance from the earth?"

This column gives the logarithm of the distance of the planet from the earth for each day, calculated on the supposition that the earth's mean distance from the sun represents unity. In the case of the inferior planets, as their distance from the earth is often less than this unit, this logarithm

[*] The Rev. H. Lowe, in whose possession the instrument now is.

(being the logarithm of a decimal fraction) would at such times have a negative characteristic; in such cases the latter is increased by 10, to avoid the inconvenience of printing. Thus, wherever 9 appears as the characteristic in this column, the *real* characteristic is − 1. From this column we can ascertain the distance of the planet from us on any particular day. Thus, for example, from page 291 the logarithm of Saturn's distance from the Earth on June 1st is 0·9527390, the number corresponding to which is 8·96875; in other words, Saturn's distance from us on that day is nearly nine times our mean distance from the Sun.

Heliocentric co-ordinates are useful whenever it is required to ascertain the place of any planet or comet in its own orbit, or in fact to work any problem in which the places of the planets with respect to one another, and their mutual attractions, are required to be taken into account. Such investigations are, with less confusion, referred to the Sun as a fixed origin of co-ordinates, than to the Earth, which is itself in motion.

I remain, Sir, yours faithfully,
Alton, Hants: Dec. 1866. ALFRED W. DEEY.

SPECTROSCOPIC OBSERVATIONS OF THE SUN.

(By J. Norman Lockyer, F.R.A.S. Communicated to the Royal Society.)

The two most recent theories dealing with the physical constitution of the sun are due to M. Faye and to Messrs. De la Rue, Balfour Stewart, and Löewy. The chief point of difference in these two theories is the explanation given by each of the phenomena of sun-spots.

Thus, according to M. Faye,* the interior of the sun is a nebulous gaseous mass of feeble radiating power, at a temperature of dissociation; the photosphere is, on the other hand, of a high radiating power, and at a temperature sufficiently low to permit of chemical action. In a sun-spot we see the interior nebulous mass through an opening in the photosphere, caused by an upward current, and the sun-spot is black, by reason of the feeble radiating power of the nebulous mass.

In the theory held by Messrs. De la Rue, Stewart, and Löewy,† the appearances connected with sun-spots are referred to the effects, cooling and absorptive, of an inrush, or descending current, of the sun's atmosphere, which is known to be colder than the photosphere.

In June 1865 I communicated to the Royal Astronomical Society ‡ some observations (referred to by the authors last named) which had led me independently to the same conclusion as the one announced by them. The observations indicated that, instead of a spot being caused by an *upward* current, it is caused by a *downward* one, and that the results, or, at all events, the concomitants of the downward current, are a dimming and possible vaporization of the cloud-masses carried down. I was led to hold that the current had a downward direction by the fact that one of the cloud-masses observed passed in succession, in the space of about two hours, through the various orders of brightness exhibited by *faculæ*, general surface, and *penumbræ*.

On March 4th of the present year I commenced a spectroscopic observation of sun-spots, with a view of endeavouring to test the two rival theories, and especially of following up the observations before alluded to.

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* *Comptes Rendus*, vol. lx. pp. 89–138, abstracted in *The Reader*, 4th February 1865.

† *Researches on Solar Physics*. Printed for private circulation. Taylor and Francis, 1865.

‡ *Monthly Notices, Roy. Ast. Soc.* vol. xxv. p. 237.

The method I adopted was to apply a direct-vision spectroscope to my 6¼-inch equatoreal (by Messrs. Cooke and Sons) at some distance outside the eye-piece, with its axis coincident with the axis of the telescope prolonged. In front of the slit of the spectroscope was placed a screen, on which the image of the sun was received; in this screen there was also a fine slit corresponding to that of the spectroscope.

By this method it is possible to observe at one time the spectra of the umbra of a spot and of the adjoining photosphere or penumbra; unfortunately, however, favourable conditions of spot (*i.e.* as to size, position on the disk, and absence "of cloudy stratum"), atmosphere, and instrument are rarely coincident. The conditions were by no means all I could have desired when my first observations were made; and, owing to the recent absence of spots, I have had no opportunities of repeating my observations. Hence I should have hesitated still longer to lay them before the Royal Society had not M. Faye again recently called attention to the subject.

On turning the telescope and spectrum-apparatus, driven by clock-work, on to the sun at the date mentioned, in such a manner that the centre of the umbra of the small spot then visible fell on the middle of the slit in the screen, which, like the corresponding one in the spectroscope, was longer than the diameter of the umbra, the solar spectrum was observed in the field of view of the spectroscope with its central portion (corresponding to the diameter of the umbra falling on the slit) greatly enfeebled in brilliancy.

All the absorption-bands, however, visible in the spectrum of the photosphere, above and below, were visible in the spectrum of the spot; they, moreover, appeared thicker where they crossed the spot-spectrum.

I was unable to detect the slightest indication of any bright bands, although the spectrum was sufficiently feeble, I think, to have rendered them unmistakeably visible had there been any.

Should these observations be confirmed by observations of a larger spot free from "cloudy stratum," it will follow, not only that the phenomena presented by a sun-spot are not due to radiation from such a source as that indicated by M. Faye, but that we have in this absorption-hypothesis a complete or partial solution of the problem which has withstood so many attacks.

The dispersive power of the spectroscope employed was not sufficient to enable me to determine whether the decreased brilliancy of the spot-spectrum was due in any measure to a greater number of bands of absorption, nor could I prove whether the thickness of the bands in the spot-spectrum, as compared with their thickness in the photosphere-spectrum, was real or apparent only.*

On these points, among others, I shall hope, if permitted, to lay the results of future observations before the Royal Society. Seeing that spectrum-analysis has already been applied to the stars with such success, it is not too much to think that an attentive and *detailed* spectroscopic examination of the sun's surface may bring us much knowledge bearing on the physical constitution of that luminary. For instance, if the theory of absorption be true, we may suppose that in a deep spot rays might be absorbed which would escape absorption in the higher strata of the atmosphere; hence also the darkness of a line may depend somewhat on the depth of the absorbing atmosphere. May not also some of the variable lines visible in the solar spectrum be due to absorption in the region of spots? and may not the spectroscope afford us evidence of the existence of the "red flames" which total eclipses have revealed to us in the sun's atmosphere; although they escape all other methods of observation at other times? and if so, may we not learn something from this of the recent outburst of the star in Corona?

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* Irradiation would cause bands of the same thickness to appear thinnest in the more brilliant spectrum.

SPECTRAL STUDIES ON SOME OF THE PLANETARY NEBULÆ.

(From the *Bullettino Meteorologico* of Father Secchi of 31st Oct. 1866.)

The spectrometer which I have described appeared to me at first incapable of giving good results upon the nebulæ, but it is not generally true. If they are of great extent, as those in Orion, &c., then the image cannot be linear, and the distinct monocromatic spectral lines are wanting. But with the planetary nebulæ it is different. Considering the apparent disc of some of these, I expected that even in the spectrometer the monocromatic zone would have a diameter equal to it; but that was not so. The planetary nebulæ, instead, give the very fine lines indicated for the first by Mr. Huggins; and as the new spectrometer enfeebles their light much less, it renders them more easy to examine. Up to the present time I have studied four of these nebulæ—the annular in Lyra; that in Sagittarius, in R.A. 19h. 34m., decl. —14°·32′, which has a diameter 25″·8; that of Struve, R.A. 18h. 4m., decl. 6°·50′, diam. 7″·6; that of Andromeda, R.A., 23h. 18m., decl. +41°·36′; greatest diam. 22″·5.

The three latter are figured in our "Memoirs" of 1856, and have a considerable diameter. These nebulæ give, in the spectrometer, the principal monocromatic line very sharp and very fine, accompanied by some other also very fine lines.

In the annular nebula in Lyra that line appears double, but there may be doubts if the duplicity belongs to the two arches of the nebula; that of Sagittarius is single, and has another very fine line as near as the other is broad, at the side of the violet, and, at intervals, a very faint distant line is visible.

That of Struve has a much brighter spectrum, and the three lines are quite distinct.

That of Andromeda has the lines above named, but the principal one is a little diffused, and all the field is slightly illuminated, and certainly it cannot be said that all trace of stellar spectrum is wanting. Thence it is important in this family of objects. Our figure drawn in 1856 shows some stellar points in it.

As it is a little paradoxical that the image of an object having a sensible diameter should be reduced to a line, it will not be amiss to explain how this happens. If, from a refractor directed towards the full moon, the eyepiece is taken away, and an achromatic lens of short focus is placed at a short distance from the principal focus, it will be seen that the image diminishes, though not much; but it will be observed that *beyond* the image the rays are concentrated in a very small space without forming there an image properly so called. Now, the same happens with the cylindrical lens; this, in one direction only, and in a place beyond the true image, produces a linear concentration of rays which occupies the place of the slit. The breadth of the image is not properly zero, but is so much diminished that its breadth appears to be insensible. That explains why I did not at first see these lines distinct, as I looked at the focal position of the stars, whilst it was requisite to look further off for the objects having a diameter. Thus also the planets, up to a certain point, give a linear image; but it is impossible to reduce their image to a convenient narrowness if the diameter exceeds some seconds, and thence it cannot be made available for all objects. But for facilitating the study of these mysterious celestial bodies, such as the planetary nebulæ, it is an advantage to be able to do it with an instrument as economical and simple as our spectroscope is.

NOTES AND GLEANINGS.

MEASUREMENT OF CELESTIAL SPACES.—"Now, on these processes we have two remarks to make. *First*, that the operations of practical astronomy, as far as they regard the fixation of the distances and positions of the heavenly bodies, depend upon one single fundamental measurement of space, just as in surveying land with a theodolite; that measurement being the single measured side of the network of triangles which (rigorously speaking) is all that is required to measure an arc of the meridian, and consequently the axial diameter of our globe. Any error in that single fundamental linear measure is *proportionally transmitted* through all the succeeding calculations. The rod used in measuring a base line is commonly somewhere about ten feet long, and the astronomer may be said truly to apply *that very rod* to mete the distance of the stars! An error in placing a fine dot which fixes the length of the rod, amounting to *one-five-thousandth* of an inch (the thickness of a single silken fibre), will amount to an error of 70 feet on the earth's diameter, of 316 miles on the sun's distance, and to 65,200,000 miles on that of the nearest fixed star! The *second* point to which we would advert is, that as the astronomer in his observatory has nothing further to do with ascertaining *lengths* as distances (except by calculation), his whole skill and artifice are exhausted in the measurement of *angles*; for it is by these alone that spaces inaccessible can be compared. *Happily, a ray of light is straight*; were it not so (in celestial spaces at least), there were an end of our astronomy. If we may be permitted a pleasantry on such a subject, it is our *beam* compass, and it is inflexible as adamant—which our instruments for ascertaining its position unfortunately are not. Now, an angle of *a second* (3,600 to a degree) is a subtle thing. It is an apparent breadth utterly invisible to the unassisted eye, unless accompanied with so intense a splendour (as in the case of the fixed stars) as actually to raise by its effect on the nerve of sight a spurious image having a sensible breadth. A silkworm's fibre, such as we have mentioned above, subtends an angle of a second, at 3½ feet distance: a cricket ball 2½ inches diameter must be removed in order to subtend a second to 43,000 feet, or about 8 miles,—where it would be utterly invisible to the strongest sight, aided even by a telescope of some power. Yet it is on the measure of one single second that the ascertainment of a sensible parallax in any fixed star depends; and an error of $\frac{1}{100}$ of that amount (a quantity still unmeasurable by the most perfect of our instruments) would place the star too far or too near by 200,000,000,000 miles—a space which light requires 118 days to travel."—*Edinburgh Review*, April, 1850.

THE STORM WARNINGS.—The suspension of these warnings by the Board of Trade has caused much dissatisfaction, no attempt having been made to ascertain the opinions and wishes of those for whose benefit the system was originated by the late Admiral Fitzroy. Mr. Baxendell read a paper on the subject at the meeting of the Literary and Philosophical Society of Manchester on December 11th, and Mr. G. V. Vernon has written concerning the matter to the editor of the *Manchester Guardian*. It is to be regretted that a system which is very generally admitted to have been the means of saving many valuable lives should have been hastily relinquished; and as it must be self-evident that it is desirable to point out the approach of a storm or heavy gale of wind, it is to be hoped that in some form or other it may be re-established.

INFERIOR CONJUNCTION OF VENUS.—Mr. Thomas Wilson, of Skipton, writes:—"I was considerably disappointed by the prevalence of cloudiness at the late inferior conjunction of Venus. I, however, observed her within 27h. 18m. of conjunction, and at about 44 hours after, with certainty of her visibility at any rate many hours nearer, if above our horizon and clear; and a strong suspicion that with these conditions, and the small difference in declination between her and the sun notwithstanding, that she would not have been entirely invisible at any time while passing the sun."

OCCULTATION OF ALDEBARAN.—Mr. J. G. Walker, of Teignmouth, says:—"I had a view of the occultation of Aldebaran last night, January 16; but my observatory dome being frozen, I was obliged to content myself with using a small telescope inconveniently mounted at a window. Being fatigued from my constrained position, I lost the moment of the star's disappearance, but it was gone at 7h. 6m. 47·5s. Teignmouth mean time, and may have been five seconds or so before. The reappearance I observed with a small hand-sweeper, 8h. 19m. 26·5s.; but neither has this any pretension to close accuracy. The star seemed bright as long as I had it in view."

Mr. Wm. Locke, of Ravensdale, "observed the occultation with a good 5-inch refractor and an astronomical clock well regulated. The time of the occultation by clock, making allowance for error, was 2h. 38m. 34s.; and I see by the almanac the time at Greenwich was 3h. 9m. 0s.; making a difference of 30m. 26s. How can I find the exact longitude of the place from this? Is the time alone a sufficient datum for the calculation? Don't you think some assistance on this subject would be desirable to many of the readers of your useful periodical? I got for this purpose Shadwell's Tables, but they don't suit; perhaps you may know some small work for finding longitude from occultations, having correct local time, to which you could refer me."

BRIEF CORRESPONDENCE.

CELESTIAL LONGITUDE.—Is there anything published and obtainable showing the celestial longitude corresponding with Right Ascension, say for each degree and reversely, by which one may be at once (roughly at least) converted into the other? T. W.

ASTRONOMICAL WORKS.—Can you inform me of the best work on Practical and Mathematical Astronomy—more especially for the actual working to calculate the orbit, &c. of an object seen for the first time.

A SUBSCRIBER.

In answer to W. S.: "Observational Astronomy and Companion to the Telescope," by J. T. Slugg (Simpkin, Marshall, & Co.); "Handbook to the Observatory," by W. A. Darby (Hardwicke); "Celestial Objects for Common Telescopes," Webb (Longmans)—one or other of these works to be used in conjunction with the maps of the Society for the Diffusion of Useful Knowledge. G. J. W.

In answer to "Curiosus," I would suggest "Dietrichsen and Hannay's Almanac," price 8*d.*; to be obtained of any bookseller.

A. W. D.

FIXING AN EQUATORIAL.—In answer to "Amateur:" Instructions for this purpose will be found in Mr. Darby's work, "Handbook to the Observatory" (Hardwicke); also in Chambers's "Handbook," Drew's "Manual," &c. G. J. W.

[N.B.—By referring to the Suggestions and Enquiries, Notes and Queries, and Brief Correspondence in former numbers of the *Register*, correspondents will in many cases find answers to their questions as to astronomical works, instruments, &c.—ED.]

ILLUMINATION OF REFLECTORS.—Would any of the readers of the *Astronomical Register* explain the best manner of illuminating the field of a Newtonian reflecting telescope, so as to obtain either the illumination of the field or of the micrometer wires? R. C. J.

ORRERIES.—G. J. W. will find his "indistinct recollections" become certainties by consulting Ferguson's "Astronomy," in which are descriptions of the Orreries, Calculator, Cometarium, Improved Celestial Globe, Planetary Globes, Trajectorium Lunare, Tide Dial, and Eclipsarem—all inventions of Ferguson. W. R. B.

THE NOVEMBER METEORS.—I shall be glad to be informed through the *Register* if the numerous observations of the late meteoric shower indicate that the bolides, as Herr Schmidt terms the meteors (before incandescence), were more condensed in the anterior portion of the group through which the earth passed than in the posterior, *e.g.*; all accounts agree in the rapid attainment of the maximum. Did this arise from the earth passing through or among the *greatest* number of bodies upon its first plunging into the group, or was it merely optical, depending upon the position of the "radient?" If the former, by what means was the condensation brought about, and what was the probable form of the group? S. J. C.

A few years since I read in some French writer, that in his opinion the deluge was caused by the disruption of large masses of ice accumulated at one of the poles, which had for about ten thousand years been more exposed to the sun than the other; the latter having, of course, been for a similar term in the enjoyment of less of the sun's rays than the opposite pole, during which time the ice had accumulated: also that a deluge, or some such calamity, must happen to our earth periodically, at intervals of about ten thousand years. Have you heard of this theory, or can you or any of your able correspondents tell me anything about it, or its claims to belief? It seemed to me when I read it to have some plausibility. If you allow such subjects to be introduced into your valuable periodical, your insertion of this will oblige, yours obediently, F.

May I be permitted to add my humble but earnest wishes to those of other subscribers, that each number of the *Register* will in future be ornamented with a frontispiece—either a photograph of some eminent astronomer, or a diagram of some leading object of interest? I for one will gladly pay my share of the additional cost; and I venture to assert that if it be put to the vote, not an individual subscriber will demur.

A LOVER OF THE SCIENCE.

ASTRONOMICAL OCCURRENCES FOR FEB. 1867.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Mars.
Fri	1		Sidereal Time at Mean Noon, 20 44 53·9	The Satellites are invisible this month, Jupiter being too near the Sun.		10 11·7
Sat	2		Meridian passage of the Sun, 13m. 58s. after Mean Noon			10 6·8
Sun	3	6 3 22 26	Conjunction of Jupiter with the Sun Conjunction of Moon and Mercury, 5° 45′ S.			10 1·9
Mon	4	6 16 7 1	● New Moon Conjunction of Moon and Jupiter, 4° 0′ S.			9 57·2
Tues	5		Declination of Mars + 26° 52′			9 52·5
Wed	6	21 3	Conjunction of Jupiter and Mercury, 1° 30′ S.			9 47·8
Thur	7					9 43·2
Fri	8					9 38·7
Sat	9	7 38 8 35	Occultation of μ Piscium (5) Reappearance of ditto			9 34·2
Sun	10					Moon. 4 49·9
Mon	11	4 43 13 40	Superior conjunction of Mercury. ☽ Moon's First Quarter			5 42·8
Tues	12	6 57 9 12 12 50 13 38 13 0 13 32 13 14 13 37	Near approach of Moon to 48 Tauri (6) Near approach of Moon to γ Tauri (4) Occultation of θ¹ Tauri (4½) Reappearance of ditto Occultation of θ² Tauri (4½) Reappearance of ditto Near approach of Moon to 75 Tauri (6) Occultation, disappearance of B.A.C. 1391 (5)			6 38·1
Wed	13	11 2 12 6 12 45 13 35	Occultation of 111 Tauri (6) Reappearance of ditto Occultation of 117 Tauri (6) Reappearance of ditto			7 35·5
Thur	14	11 55 23 44	Conjunction of Moon and Uranus, 5° 27′ N. Conjunction of Moon and Mars, 8° 44′ N.			8 34·3
Fri	15	7 11	Near approach of Moon to λ Geminorum (3½)			9 33·4

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon. —
Sat	16	 12 13 13 19	Sidereal Time at Mean Noon, 21 44 2·2. Occultation of 29 Cancri (6) Reappearance of ditto			10 31·4
Sun	17					11 27·5
Mon	18	7 41	○ Full Moon			12 21·0
Tues	19		Meridian passage of the Sun, 14m. 6s. after Mean Noon			Mars — 8 52·7
Wed	20	14 46	Greatest westerly elongation of Venus, 46° 44′			8 48·8
Thur	21		Declination of Mars + 26° 32½′			8 45·0
Fri	22					8 41·3
Sat	23					8 37·6
Sun	24	19 31	Conjunction of Moon and Saturn, 2° 20′ S.			8 34·0
Mon	25	23 32	☾ Moon's Last Quarter			8 30·4
Tues	26					8 26·8
Wed	27					8 23·2
Thur	28					8 19·8

THE PLANETS FOR FEBRUARY.

Mercury will be an evening star after the middle of February, and at the end of the month may be seen for about an hour.

		h.	m.	s.			°	′		
1st	R.A.	20	31	12	Decl.	—	20	57	Diameter	4″·8
15th	„	22	8	53	„		13	23½	„	5″·0

Venus, although still very much south of the equator, may be well observed before sunrise, preceding the Sun about three hours at the beginning of the month. The planet is well adapted for transit observation, passing the meridian within a few minutes of nine o'clock A.M. during February.

1st	R.A.	17	48	1	Decl.	—	18	48½	Diameter	30″·6
15th	„	18	41	26	„		19	30	„	26″·2

Illuminated portion of the disc of Venus, 0·463.

Mars continues to be very well fixed for observation, and remains very much in the same position with regard to the stars as during last month.

1st	R.A.	6	58	39	Decl.	+	26	52	Diameter	15″·6
15th	„	6	50	16	„		26	43	„	12″·0

Illuminated portion of the disc of Mars, 0·954.

Jupiter is in conjunction with the Sun this month, and consequently is unfavourably placed for observation.

1st	R.A.	21	6	29	Decl.	—	17	15½
15th	„	21	19	49	„		16	17

Saturn rises about two o'clock in the morning at the beginning, and about half an hour after midnight at the end of the month.

1st	R.A.	15	26	4	Decl.	—	16	28	Diameter	15″·0
15th	„	15	28	20	„		16	33½	„	15″·4

Dimensions of Ring—Outer Major Axis, 38″·0; Outer Minor Axis, 15″·0.

Uranus continues well fixed for observation, not far from Mars.

6th	R.A.	6	21	17	Decl.	+	23	41	Diameter	4″·2
18th	„	6	20	1	„		23	42	„	4″·0

TOTAL DESTRUCTION OF AN OBSERVATORY BY FIRE.—The observatory at Downside College, near Bath, was on Sunday last, January 20, completely destroyed by fire, with all its valuable contents. The 14½-inch object-glass, the transit circle, and all the smaller instruments, together with a valuable museum attached, fell victims to the flames. Nothing could be saved, although the fire broke out in the day time, and, unfortunately, nothing was insured. This observatory was probably one of the largest and handsomest private observatories in the kingdom, and it was only about two months ago that it was fully completed. The exact cause of the disaster has not been ascertained.

LUNAR RAINBOW.—Mr. Barkas, of Newcastle-on-Tyne, informs us that a brilliant instance of this phenomenon took place on the evening of December 19th, lasting from 7 o'clock to 7.35; the prismatic colours were very distinct, and the general effect most gorgeous.

INSTRUMENTS, &c. FOR SALE.

These Notices, which are restricted to *two lines* each, are inserted free of charge to subscribers: applications respecting prices and other particulars to be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—For Advertisements with prices and more complete details, a small charge will be made.

N.B.—It is particularly requested that we may be informed when instruments are disposed of, in order that the notice may be withdrawn, and fruitless applications prevented.

Achromatic Refractor, 6·4 in. ap. 8½ ft. focus, by *Merz,* Equatorial and clockwork by *Troughton & Simms.* [73]

Achromatic Refractor, 4 in. ap. 5 ft. focus, by *Dollond;* equatorially mounted. Powers up to 400. [87]

Dialyte Telescope, 4¼ in. ap. 5 ft. focus, price very low. [88]

Gregorian Reflector, 4¾ in. ap. 2 ft. focus, by *Dollond,* 4 powers, 50 to 200, finder, &c., on brass table stand. [63]

Achromatic Object-Glass, 4⅛ in. ap. 62 in. focus, by *Slugg,* with brass cap and receiving cell, for mounting on tube. [85]

Newtonian Metal Speculum, 8 in. ap. first-class quality. [77]

Transit Instrument, 3¾ in. ap. 5 ft. focus, Ys fitted with agates for mounting on stone piers. [29]

Equatorial Stand, for a 5 or 6 ft. telescope: 13 in. circles, divided on silver, to 10″ of space and 4s. of time.—Has never been used. [55]

Varley Stand, improved, rackwork movements, for a telescope of 5 or 6 ft. focus: on circular turn-table, to point in any direction. [16]

Polar Axis, of mahogany, 7 ft. long, adapted for a 4 ft. telescope, with 12 in. circles, reading to minutes. [56]

Speculum Grinding Apparatus, capable of working a 7 ft. speculum: with tube and fittings for a 9 in. Newtonian. [57]

Electrical Machine, powerful, 18 inch ebonite plate, by *Silver & Co.,* with brass conductor. [93]

Electrical Machine, plate 12 inches in diameter, in case complete. Price low. [90]

Recreative Science: and the first three volumes of the **Photographic Journal:** price very low. [30]

Wollaston's Fasciculus Astronomicus, a good copy, well bound: also **Denison's Astronomy** without mathematics. The two, 3*s.* [94]

INSTRUMENTS, &c. WANTED.

Equatorial Telescope, about 6 in. aperture, with driving clock and circles; price moderate. [89]

Astronomical Clock, not very first-class; price low. [65]

Gregorian Reflector, second-hand, not less than 9 in. diameter; or a dumpy **Newtonian,** not over 5 ft. focus, without stand. [95]

Equatorial Stand, for a 5 ft. Refractor: graduated circles. [35]

Transit Instrument, 2 in. ap. 18 or 24 in. focus. [71]

Monthly Notices of the Royal Astronomical Society, Vol. 3. [26]

Monthly Notices: Vols. 3, 4, 5, and 7. [82]

Bartholomew Prescot on the Universe, published 1823: a copy wanted, in good condition. [84]

Eclipse of the Sun.—An annular eclipse of the Sun, partially visible at Greenwich, will take place on the morning of the 6th of March, beginning at about a quarter-past eight o'clock.

		h.	m.	
Eclipse begins	March 5	20	17·2	mean time at Greenwich.
Greatest phase		21	31·8	"
Eclipse ends		22	51·9	"

Magnitude of the Eclipse (Sun's diameter = 1) 0·750.

The Tribute of Science to Revealed History is the title of a little work just published by Mr. J. W. Harris, of Exeter. Certain ideas concerning the unimaginable extent of time employed in many of the phenomena of Geology, which had suggested themselves to the author, having been confirmed by lectures delivered by Mr. Pengilly, at Torquay, Mr. Harris has transcribed the proofs as they came before him, and drawn inferences from them which are here given for the consideration of others. Mr. Harris enforces his arguments by illustrations from Botany, Geology, Astronomy, the Spectroscope, &c., showing their agreement with revealed History, of which he considers we should expect to find, sooner or later, both a literal and a symbolical fulfilment.

The Continuity of the Schemes of Nature and of Revelation, by the Rev. C. Pritchard, is a valuable production, and deserves to be extensively read.

LIST OF SUBSCRIBERS—Names received since our last number.

Anthony, J., Esq., Washwood, Birmingham.
D'Alquen, F. M., Esq., 8 Montpellier Terrace, Brighton.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1866.

Dallmeyer, J. H.
De la Rue, W.

To March 1867.

Birmingham, J.
Burlingham, J.
D'Alquen, F. M.
Freeman, D. A.
Jackson, Mrs.

To June 1867.

Anthony, J.
Briggs, Miss.
Cook, Jas.
Court, J.
Dawes, Rev. W. R.
Dell, T.
Howlett, Rev. F.
Jefferies, J.
Lee, J.
Rump, H. R.
Smith, W.
Vertu, J.

To December 1867.

Baldelli, Mdme.
Bird, F.
Collingwood, E. J.
Cundell, G. S.
Deey, Rev. A. W.
Gilby, J.
Glover, Rev. J. H.
Hunt, G.
Lewis, R. T.
Roberson, C.
Stanistreet, J.
Tidmarsh, Rev. J. B.
Troward, C.
Thomson, Prof.
Vernon, G. V.
Walker, G. J.
Wilson, T.

To March 1870.

Lettsom, W. G.

NOTICES TO CORRESPONDENTS.

Several communications are deferred for want of space.

Errata.—In last number, p. 17, Trisection of an Angle, Example 8, *for* DMM *read* DNM, and *for* AMB *read* AMD.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Stamford Villa, Downs Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 51. MARCH. 1867.

On the Performance of Object Glasses on Gamma Andromedæ and Delta Cygni.

By the Rev. W. R. Dawes.

Among the correspondence in the number of the *Astronomical Register* for the present month will be found a letter signed " A Subscriber," and headed " *Performance of Object Glasses.*" In this the writer states that he is " informed on the best authority (the Rev. H. Lowe, in whose possession the instrument now is) that the 8¼-inch object glass by A. Clark does *not* show γ^2 *Androm.* triple, *nor* δ *Cygni double.*" (As I never heard of γ^2 *Androm.* having been seen *triple*, I presume that γ^2 is a mistake for γ, including the duplicity of γ^2.)

Astonished that such an assertion should have proceeded from Mr. Lowe, I wrote to him, and in reply he informed me that he had been led to doubt whether he saw γ^2 *Androm.* correctly, by the fact that two diagrams had been sent to him, drawn by two gentlemen of Manchester, whose names he mentioned—one ot whom had seen the object through the 8¼-inch, and drew the diagram *from memory only*; and the other had seen it with a 9-inch object glass by Slater.

Curiously enough, these diagrams are almost exactly alike; and as they differed very widely from what Mr. Lowe had himself seen and depicted, he distrusted the correctness of his own observations. That no error might be introduced in the process of copying the diagrams, I requested Mr. Lowe to send me some careful *tracings* on tracing paper. This he has done, and included also some tracings of a diagram he had received from Birmingham, and of his own diagrams at several different times. Certainly, no one would imagine that these were all representations of the same object; the angle of position of γ^2 as depicted by the Manchester observer being about 224°; by the Birmingham observer about 65°; and by Mr. Lowe about 124°. As the true angle is about 108°, it follows that the Manchester diagram is erroneous by + 116°, the Birmingham one by + 43°, and Mr. Lowe's by + 16° only, which is as near as might reasonably be expected in a hasty diagram on a very small scale, and intended only to record approximately the appearance of the object in the telescope. In this the components of γ^2 are well separated even with a power of 292, with 500, widely enough to be well measured in distance. Mr. Lowe's diagram of δ *Cygni* is also quite correct, though representing the image as seen with a power of only 185.

Having had the telescope in my possession for several years, and always used it with satisfaction, I feared that some sad accident had happened to it, and have thought it only due to my excellent friend, Mr. Alvan Clark, to place the performance of his 8¼-inch object glass in its true light; and as I have now no reason to suppose that it has been materially injured since it left my observatory, I will transcribe one or two notes entered at the time of observation in my book of double-star measures.

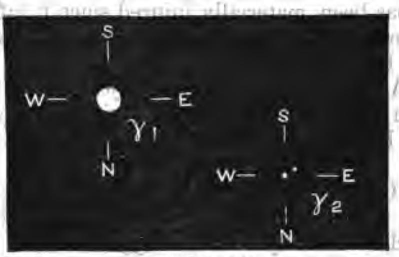
"γ^2 *Androm.* With Alvan Clark's 8¼-inch Object Glass—1863·863. Exquisitely seen; *B.* & *C.* clearly divided, with scarcely any light round them. *A.* has a splendid disk, with one complete ring. Power 486."

"δ *Cygni.* With A. C.'s 8¼-inch Object Glass—1859·612. Beautifully seen. . . . I think I never before saw this difficult object so well, or measured it so easily. Power 635."

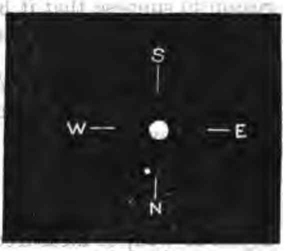
From the expressions used by several of your correspondents respecting these two objects, which seem to have become favourite tests of telescopic performance, I conclude that their character, especially that of δ *Cygni*, is not by many correctly understood. The brightness of γ *Andromedæ* renders it easy to find without an equatoreal mounting, and it is therefore often referred to as a test object; but the close pair is by no means a difficult object for any moderately good object glass, whose aperture is sufficient to reduce the disks of the components to about 0″·60 or 0″·58 in diameter. The smallest aperture which will do this is about 7¾ inches. A somewhat smaller may so nearly separate them as to produce a *dark line* across the elongated and deeply-notched disk; but when the image is sufficiently quiet to admit of accurate scrutiny with a high power, a slight flattening of each disk will be perceived at the point of contact, just as Mr. Knott has described the image formed by his excellent 7⅓-inch object glass. That the two stars should be *separated* with any object glass of only 5¼ inches aperture is out of the question, and I feel sure that Mr. Alvan Clark would never assert that it could. There must be some mistake in Loomis's "Progress of Astronomy," referred to by your correspondent.

δ *Cygni* is quite a different kind of object, the small star being nearly 1″·7 from the centre of the large one. The difficulty here is, of course, not to *separate* the stars, but to place *B.* out of the way of the bright ring surrounding *A.*, which is usually too bright to permit *B.* to be distinctly and certainly seen through it. An aperture of 4 or 4¼ inches may show *B.* just *within the ring*; but to diminish the radius of the ring's exterior edge to 1″·7 requires an aperture of 5¾ inches at least. With this and larger apertures, all that is wanted is a moderately good figure and correct adjustment of the object-glass, with a quiet image, free from any considerable flashing or "brandishing" of the rings.

For the information of those who may doubt whether they see these objects correctly, I append a diagram of each as seen on the meridian with the 8¼-inch object glass. These diagrams are drawn to a scale.



γ Andromedæ



δ Cygni

PERFORMANCE OF OBJECT GLASSES.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I was exceedingly surprised by the statement in the letter from "A Subscriber," in the last number of the *Register*, that an 8¼-in. object glass by Alvan Clark had failed to divide γ^2 Andromedæ, and cannot but think that there must be some mistake. Indeed, if I am right in believing that the instrument in question was formerly in the possession of the Rev. W. R. Dawes, the following remarks by that gentleman in the Monthly Notices of the Royal Astronomical Society (vol. xx. No. 2) convert my suspicion into a certainty. Mr. Dawes observes:—

"The object glass of the telescope has a clear aperture of 8¼ inches, and a focal length of about 110 inches. . . . Its performance fully supports the character of Mr. Alvan Clark's object glasses, and I believe it to be capable of everything which can be performed by such an aperture. It clearly divides γ^2 Andromedæ, and shows the smallest companions among the stars of the Pulkova Catalogue."

May I take the opportunity of reminding some of your readers that, other things being equal, the *separating* power of a telescope depends solely on its *aperture*? This is owing to the fact that the image of a star as seen in a telescope is a circular disk,* rapidly decreasing in brightness towards the margin, and degrading to a ring of absolute blackness,—surrounded by a series of alternate bright and dark rings, the intensities of the bright rings being respectively about 1/57, 1/240, and 1/620 of that of the centre disk. The diameters of the disk and rings vary inversely as the aperture of the telescope; or, in other words, the *larger* the diameter of the object glass, the *smaller* is that of the apparent image of the star. It follows from this that two stars closely juxtaposed will appear more widely separated in a telescope of *large* than in one of *smaller* aperture—*i.e.* the *separating* power of the former will be greater than that of the latter. It will be noticed that the disk itself has no visible boundary, and of course we only see so much of it, in any case, as possesses sufficient brightness to affect our eyes. This explains why the apparent image of a faint star is less than that of one higher in the magnitude scale.

In regard to δ Cygni, I will only remark that it was measured in 1851 by Mr. Fletcher, with a telescope having a clear aperture of 4½ inches, and as the distance of the components is sensibly unchanged, I presume that a similar aperture would show them at the present time. It has indeed been suggested that the small star is variable, but the evidence on this point is at present very uncertain. In the autumn of last year it was, to my eye, of about the 8¾ magnitude. It is hardly necessary to add that, in the observation of all objects of a delicate nature, a little judgment as to time and circumstance, a little patience and a delicate manipulation, are indispensable requisites.

Your correspondent asks whether the 15th magnitude of the Bedford Catalogue is the limit for a 5-inch object glass. I believe that such would be approximately the case. The corresponding magnitude on Struve's scale would be approximately 10·9, and on Mr. Pogson's standard scale (Argelander's extended to the lower magnitudes, in accordance with a light-ratio of 2·512) the corresponding magnitude would be about 12·7.

In conclusion, may I submit the following correction to my letter on the Lunar Crater Linné in your last issue? On page 33, line 2 from the bottom, for "*larger* than *than* of Sulpicius Gallus," read "*less* than *that* of Sulpicius Gallus."

I am, Sir, yours faithfully,

GEORGE KNOTT.

Woodcroft Observatory, Cuckfield:
February 11th, 1867.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I must beg leave to express, through your pages, my surprise that any friend to whom I may have incidentally and privately mentioned some temporary apprehension that my 8¼-inch Alvan Clark did not do all that I looked for from it with γ Andromedæ and δ Cygni, should have felt at liberty to publish such communication in the *Astronomical Register* without warrant from me.

Before the instrument came into my hands, Mr. Dawes had shown how certain screws were adapted to the adjusting the sit of the object glass. On putting up the telescope, I too hastily concluded the development of blue fringe round bright star to show the cell to have been slightly disarranged in the journey, and too adventurously handled the screws. Though there are not, as I conceive, more than a dozen of objects in the "Celestial Cycle" that I cannot feel fairly satisfied of my having seen, I cannot but reckon myself to have disturbed the beautiful order in which I am sure the instrument was forwarded. Several months back I made arrangements for securing readjustment, but the precariousness of the sky has, till now, forbidden the carrying of them into effect.

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* Airy's *Undulatory Theory of Optics*, p. 80.

I ought to say, too, that I had been led to distrust diagrams of γ Andromedæ made in 1865 and 1866, by two supplied from correspondents. A friend who was with me in September last assured me that he saw a dark line, unmistakably, between B. and C. On the night of January 3 of the present year, I had no misgiving but that I saw the companion thoroughly divided into two with a power of 292; and the diagram I made at the time did not materially diverge from those of the previous years.

My cycle shows diagram of δ Cygni too. No one who knows anything of Mr. Alvan Clark's work can for a moment entertain a misgiving of its accomplishing all that comes within the compass of the diameter he may be employing.

Mr. Dawes, in 1864, assured me that δ Cygni is, without doubt, one of the most difficult double stars to see well; but it was (just before the sending off of the telescope) beautifully defined with powers from 360 up to about 600.

I remain, yours truly,

Atherstone, February 13, 1867. H. E. LOWE.

ROYAL ASTRONOMICAL SOCIETY.

Fourth Meeting, February 8, 1867.

The Annual General Meeting.

The Rev. C. Pritchard, M.A., F.R.S., *President*, in the chair.

Secretaries—Mr. Hodgson and Mr. Stone.

The obituary for the past year includes Dr. Whewell, Sir G. Everest, Dr. Lee, H. Goldschmidt, and Mr. J. Breen. The report as to the progress of Astronomy touches upon Delaunay's Lunar Theory; Newcomb's Tables of the Planet Neptune; Gould's Reduction of D'Agelet's Observations; the Supposed Change on the Lunar Surface; Comet I., 1866; the Variable Star T Coronæ, &c. The usual amount of work had been accomplished by the various observatories, and Mr. De la Rue was about to mount a silvered glass speculum of the same diameter as his present one, 13 inches, in addition to his object glass of the same diameter corrected for actinic rays.

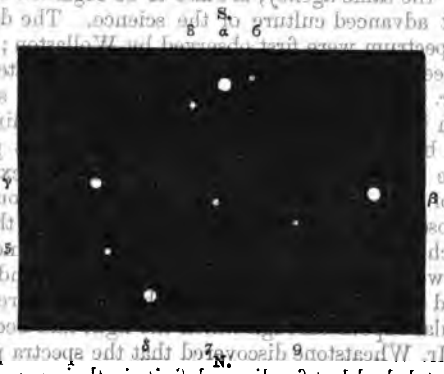
The Society's gold medal was awarded to Messrs. Miller and Huggins conjointly, for their work in the spectrum analysis of the celestial bodies—this being the first time that the medal has been awarded for conjoint labours. We can only just allude to the various topics touched upon in the President's address, as we hope to give a fuller account of the proceedings in our next number. After alluding to the rapid advance towards completeness which the science of Astronomy has made of late years, and to the many circumstances which have conspired to give its cultivation a strong impulse in a new direction, Mr. Pritchard went into some details as to the great increase in the size and power of the instruments now employed as compared with those of even only a few years back. When the elder Struve commenced his illustrious career of observation at Dorpat, he had to content himself with a Dollond telescope of only 4 inches aperture—the largest then available. Numerous instruments of more than twice that size are now to be found in the hands of public and private observers. The introduction of the methods of recording observations by means of electricity, and the more exact mode of time-keeping by the same agency, are also to be regarded as adding to the present advanced culture of the science. The dark lines in the solar spectrum were first observed by Wollaston; these lines were, thirteen years afterwards, measured with greater nicety by Fraunhofer. In 1830 Mr. Simms constructed the spectroscope with which we are now familiar, and which the admirable prisms introduced by Mr. Browning have rendered almost perfect. It was in the year 1832 that Sir David Brewster examined the spectrum of light after it had passed through the vapour of nitrous gas, and observed a vast number of interruptions in the luminous band, which resembled Fraunhofer's lines. Exact measurements proved, however, that they were not identical; and Professors Daniell and Miller demonstrated that these lines were peculiar to the particular vapour through which the light had been observed. In 1835 Mr. Wheatstone discovered that the spectra produced by burning metals had but few lines, definite in their arrangement and somewhat widely separated. Although many men great in science were now in possession of the leading truths of the discovery, it was reserved to Kirchoff, in 1859, to group all the phenomena in one consistent whole. The President then gave a detailed account of the long-continued labours of Professor Miller and Mr. Huggins, by which the process of spectrum analysis had been successfully applied in examining the nature and constitution of the heavenly bodies; and concluded by presenting the medal awarded to them by the Society for their conjoined labours in this interesting field of research.

The Rev. C. Pritchard was re-elected as President for the ensuing year, with Mr. Stone and Mr. Huggins as Secretaries.

THE TRAPEZIUM OF ORION.

The accompanying diagram of the stars in this well-known group was prepared for us last year by Mr. Huggins, and was indeed a revised copy of that which appeared in the Monthly

Notices of the Royal Astronomical Society. Unfortunately, a press of matter at the time prevented its appearing in our pages until the constellation had passed from observation. The small stars, Nos. 7, 8, and 9, Mr. Huggins states, are extremely faint, and could only be expected to be seen with an aperture of 8 inches on nights of unusual clearness. It is not possible in a woodcut, or indeed in any diagram, to represent the small stars as faint as they ought to be, observable indeed only by glimpses. The object, however, is more to give their positions, to enable the observer to look for them, than to represent them as they appear in the telescope. No. 5 is the largest of the small stars; then 6, 7, 8, and 9, in the order of their numbers.



THE TRAPEZIUM OF ORION, AS SEEN BY MR. HUGGINS, F.R.S., JANUARY 1866.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—On the night of Friday, January 25th, I was examining the Orion nebula with a 6½-inch silvered glass mirror. I saw six stars in the trapezium, the star marked 6 in the diagram I enclose being easily visible, while the star marked 5 could only be glimpsed at intervals and with difficulty.

Last night I was again observing the trapezium with an 8½-inch silvered glass mirror, and to my surprise the star marked 6 was barely perceptible, while the star marked 5 was very plainly seen indeed.

Both of these observations were verified by practised observers.

Can the stars I have alluded to be thus rapidly variable?

I shall be glad of any information on the subject,

And remain, Sir, your obedient servant,

Upper Holloway: JOHN BROWNING.
Jan. 29, 1867.

[In the diagram sent by Mr. Browning, the star (5) occupies the same position as 5 in that of Mr. Huggins, while the star (6) is close to β on the west side.—Ed.]

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

THE LUNAR CRATER "LINNÉ."

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The following extracts from a letter addressed to me by Herr Schmidt, of Athens, will doubtless be acceptable to your readers, especially in connection with Mr. Knott's and Mr. Key's letters.

I am, Sir, your obedient servant,

42 Sewardstone Road West, Victoria Park, London, N.E.: Feb. 6, 1867.

W. R. BIRT.

"From 1866, October 16, to 1867, January 24, I have observed Linné at every opportunity the weather permitted, the result being as follows:—

"1. In high illumination, Linné is *always*, as in preceding years, visible as a light spot, somewhat fainter than γ Posidonius. The difference of the Sun's height has then no perceptible effect upon its appearance. Not until the Sun's height becomes less than 5° is the light spot smaller and fainter.

"2. In lower altitudes of the Sun, and close upon the phase, not only is a crater *never* visible, but there appears, in good light and with magnifying powers from 300 to 600 at most, a very delicate hill of 300 toises (1918·4 English feet) diameter and 5 to 6 toises (between 30 and 40 English feet) in height. As a *crater*, Linné has entirely disappeared.

"The *light spot* is *always* visible, but the crater form has never been visible from October until the present time.

"January 24, 17h. to 18h.—Linné had a faint light tail of a mile (3800 toises or 4·6 English miles) in length, which I had not remarked since October.

"January 25, 14h. to 16h.—Light exceedingly good. Decreasing Sun, height on Linné now 12° to 13°. No crater, and the light cloud visible. In it (as on Dec. 26) a very fine black point, and to the west of it a fine white summit.

J. F. JULIUS SCHMIDT."

The delicate "hill" and "tail" which Herr Schmidt speaks of are highly interesting features. It would be well to watch the latter with a view of ascertaining if it presents any character in common with the streaks from Messier.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The correspondence on this alluring subject in the last *Register* is both long and interesting. From it we glean an important fact, viz., that while in December nothing more than a roundish whitish cloud occupied the place of Linné, at the last lunation this cloud had become so much thinner that glimpses of the ring of Linné were detected through it. This so closely agrees with my own observations made with greatly inferior means, that I am induced to send you a note of them, and I hope the subject will receive the attention which it demands.

My attention was first called to Linné by a circular from Mr. Birt, and on December 13th, at 8.15 P.M., the crater must have been just within or very near the terminator; the air was beautifully clear, and the Moon seen with a 2-ft. Gregorian reflector of 4-inch aperture was a beautiful sight, exquisitely defined, but Linne was utterly invisible.

Dec. 14, 8.15 P.M.—The place of Linne was distinct enough, occupied with a roundish whitish speck, easily seen with any power, but best with a low power of 50. 16th—The same appearance. I used 50 and 75 on the reflector, and 65 and 200 on a good 2-inch achromatic, but found it the same with all powers.

1867, January 13th, 14th, 15th—Three good evenings for observation. The whitish spot is certainly larger, perhaps slightly brighter; the ring of the crater is seen by glimpses, as if through thick haze; and though no positive shadow is seen, I fancy the interior dark.

It would be very interesting to know the cause of all this changing appearance—whether it is some kind of cloud, through which we see the crater, or whether it is in actual eruption, as some of the weekly journals would have us believe is the case; but we must patiently observe and wait ere we speculate on such mysterious appearances—probably the next lunation may throw more light on the subject.

Yours truly,

CHARLES GROVER.

Blucher Street, Chesham, Bucks:
Feb. 3, 1867.

BIELA'S COMET.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The complete dispersion of Biela's Comet would almost seem now to be, as our Transatlantic cousins would say, a great fact—for we are certainly required, in the language of Mr. Chambers ("Descriptive Astronomy," page 278, note), "to ignore certain alleged observations of something which formed a topic of discussion at several meetings of the Royal Astronomical Society in the spring of 1866."

Some remarks by Professor d'Arrest, of Copenhagen, recently published in the *Astronomische Nachrichten* upon the subject, appear to me to be sufficiently interesting to induce me to ask you to insert the following translation of them in the next number of the *Register*:—

"The conjecture that Biela's Comet has, after its known separation into two parts, suffered, by the continued operation of similar causes, a more recent dispersion into many smaller parts, appears in general to offer no particular difficulty." This supposition has by no means the novelty which has been attributed to it; on the contrary, it has more than once been expressed in reference to the very first comet of short period with which we have become acquainted. I well remember Encke, who had carefully considered the relations of brightness of his own comet, saying in my presence about twenty years ago, on the occasion of one of its first reappearances, 'It will gradually become fainter and fainter, and in no long time nothing of it will be left.' In books also similar expressions will be found; I confine myself to mentioning one, written by Encke so early as the year 1823, in 'Bode's Jahrbuch' for 1826 (page 128), '. . . . the doubt still remaining whether a diminution of the intensity of its light may not, after a series of years, quite withdraw it from our sight. From the shortness of its period it would even then appear during our observations *to be dissipated.*' Something has also been said on this subject in the *Astronomische*

Nachrichten. But neither the expressions of preceding astronomers, nor the approval or disapproval of those expressions by their successors, can decide concerning the destination of comets in the solar system. In this matter, as in all others, the development of the phenomena can alone lead to positive conclusions. That Biela's Comet may once more suggest an unexpected solution must be allowed; but, in face of the important fact of its non-appearance, an explanation cannot be rejected which connects together in a simple manner all the occurrences observed, without devising in addition a new cause for what has taken place. The disappearance then of this comet seems to me to be only a consequence of phenomena which have been separately observed before, and in reference to which many remarks have already been placed on record."

D'Arrest proceeds to state that no errors in the calculations of the places of the comet, all which had been most carefully revised, would suffice to explain the failure in re-finding the comet.* He affirms that so diligently had it been looked for in Copenhagen, that it could not have escaped him if all the corrections for perturbations since 1852 had been applied with wrong signs; nay, that had it been visible in the usual manner in November or December 1865, he must have seen it, whatever part of the heavens it had been in. And he concludes:—

"Its non-appearance makes it profitable to call attention to a circumstance in Bond's beautiful drawings of Donati's Comet. All astronomers are agreed that these drawings cannot be surpassed for their fidelity and the credit they reflect upon the exact comprehension and careful attention of their author. Look now at the plates in Bond's work—for example, the 16th, 17th, 18th, and others. Do they not suggest in the clearest manner that appearance can lead, to the idea that in the case of this comet also matter has been thrown off and left behind in space? Are not the layers of this thrown-off matter constantly seen in the positions and places which the comet had, owing to its onward progress, occupied one or two days before? This is indeed not new; it may likewise be pointed out in other drawings of older comets, but it appears to have been too little thought of."

I am, Sir, yours faithfully,

Greenwich: Feb. 14, 1867. W. T. LYNN.

HEIGHT AND ORBIT OF THE NOVEMBER METEORS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I write to call the attention of astronomers to the significance of the fact, much overlooked, that a stream or shower of meteors, corresponding with that witnessed here on the night of the 13th and early morning of the 14th of November, and noted in Glasgow by Professor Grant and Mr. Herschel, was observed, the same night and early morning, as far south as the Cape of Good Hope.

The *Cape Argus* informed us, and communications since received have confirmed the statement, that before midnight of the 13th a brilliant display of meteors was seen from the west wing of the Cape Observatory, and that afterwards as many as 2,742 were counted between 1.3 and 4.21 A.M. by Mr. Geo. W. H. Maclear, and his assistant, Mr. Linfield.

The difference of meridian between the Cape Observatory and Glasgow

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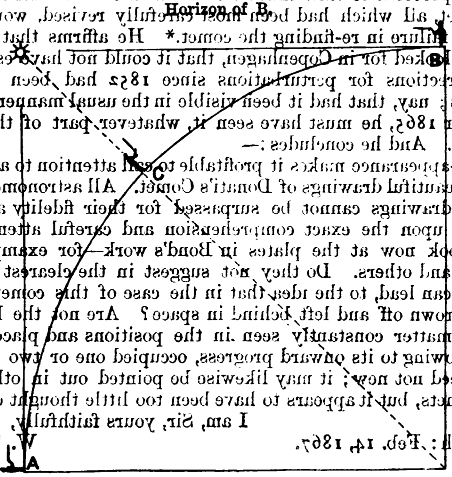
* He here refers to Weiss's remarks in *Ast. Nach.* 1577, of which you published a translation I sent you in the *Register* for May 1866.

Observatory † is not great, but, in latitude, ‡ is that of a whole quadrant, or 90°—equal, say, to 6,210 miles; and the questions that arise are (1), were Professor Grant and Mr. Maclear (separated by such a distance) watching the same meteors? or (2), watching the same stream of meteors? or (3), different currents only of the same stream?

The latter has been the answer given—but not, I think, conclusively—by some whose opinion is entitled to respect, and who have been led to adopt, perhaps too hastily, the theory of a *planetary* meteoric orbit, which the earth, they assume, has periodically to cross, and in which, for a time, while crossing, it may be supposed to be immersed.

The problems involved will be best considered by the help of a diagram showing the positions and the earth's curvature:—



Earth's semi-diameter, 3,963 miles.

A and B are two observers, 90° of latitude apart, pointing towards the same meteor on the horizon of each. C is a third observer, occupying a middle position between A and B, pointing upwards towards the same meteor in his zenith. The distance of the meteor from A, and also from B, is equal to the length of the earth's semi-diameter—3,963 miles. The distance in height of the meteor above C is (by the 47th of Euclid and Logarithmic Tables), a fraction above 1,641 miles.

Upon which we have to inquire—What, by the laws of perspective, must be the size of a blazing body, or what must be the intensity of its light, to be visible to the unassisted eye at either the one distance or the other? The stones called meteorites, that sometimes fall from meteors after their gaseous elements have been dispersed by explosion in the air, are, for the most part, of small dimensions; but if Ætna, on fire, were raised to the

† Longitude—

	h.	m.	s.	
Glasgow	0	4	17	W.
Cape	1	13	55	E.
	1	18	12	

‡ Latitude—

	°	′	″	
Glasgow	55	51	32	N.
Cape	33	56	3	S.
	89	47	35	

position of the meteor in the diagram, could it be seen from any part of the earth's surface even as a spark?

As all objects of sight diminish to the eye in proportion to their distance, it is probable that the smaller planets of our system are only rendered visible by the refractive powers of the earth's atmosphere, which act upon bodies above or beyond it as a magnifying lens, by collecting and converging the rays of light; but meteors, when seen, are, on reasonable grounds, believed to be not above but within the earth's atmosphere, and should therefore have the same vanishing points as objects of equal magnitude, which disappear when beyond the range of unassisted vision.*

Again, although it may be an error to limit the earth's atmosphere to from thirty or fifty miles, must not the gases that support combustion be too finely attenuated, at the height of 1,641 miles, to offer the resistance necessary to develope light and sparks by friction?†

These considerations lead fairly to the conclusion that the meteors of November were in much nearer neighbourhood to the observers than the meteor of our diagram; but this does not prove that the meteors of the Cape and of Glasgow were not the same, or of the same current, because, if not stationary, but proceeding from south to north, or from north to south, they must change their terrestrial latitude during the period of transit.

Bearing this in mind, and that the possible change of latitude was equal to 87°, or 43½° on each side of the equator, if the angle of the current have been correctly given at 20° with the plane of the ecliptic, the possibility of the same meteors being seen, on their way, within a very short interval, by the inhabitants of the northern as well as of the southern hemisphere, becomes at once apparent; especially if we may regard these "celestial fireworks" as, in part, electrical.

For the necessary rapidity of flight we may take with us the fact reported by Sir William Thomson, that the electric current which passes through the Atlantic cable becomes sensible between Valentia and Newfoundland within two-tenths of a second!

A very near neighbourhood for the meteoric current is suggested by the appearance of stragglers from the main stream, as "shooting stars," almost every night in the year—a phenomenon somewhat inconsistent with Mr. Newton's hypothesis of a meteoric *planetary* orbit; which, however, has again been brought forward, in an able paper in *Good Words* for January, by the President of the Royal Astronomical Society, the Rev. C. Pritchard. Against it, and in favour of another theory—that the earth, and not the sun, is the true centre of the meteoric orbit—there are these further arguments.

First, if the earth, by its gravitation, have the power to prevent so large a body as the moon from running away as a planet, on its own independent course, it must surely have equal influence upon smaller wanderers of space approaching within lunar distance.

Second, the apparent retrograde motion of the November meteors, which has been thought to show an independent orbit, may be explained by that of the moon, which also appears retrograde when she is falling behind the earth; although as a satellite she is, at the same time, advancing with her primary.

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* "A stony mass, which would weigh a hundred tons, however strongly illuminated by the sun's light, would not be visible at the distance of eight hundred or a thousand miles."—*Museum of Science and Art.*

† The common statements, that friction at great velocities is the cause of the light of meteors, require some qualification. The results of friction differ according to the nature of the substances brought into contact. If a blazing meteor, composed of the same substances as ordinary meteorites, were to pass into an atmosphere of carbonic acid, it would as certainly be extinguished as it is by water, when falling into the sea. A meteorite of magnesium might prove an exception.

Third, the earth could not cross or pass *through* a planetary stream without intercepting a considerable portion of it; in which case we should have seen most of the November meteors, not passing over us, but falling down upon us, or have felt them crushing us; for if solids, such as the meteorites of the British Museum, most assuredly they would not alight on our heads like flakes of snow. It is impossible to conceive of a collision with such bodies meeting us, *en masse*, at a calculated rate of velocity "of between thirty and forty miles a second," without disastrous effects.

Meteorites fall upon the earth, and have been known to do considerable mischief; but their rate of descent has not been at this rate. It is rare that any of them have the force to penetrate more than six feet in the ground, and the majority rest upon the surface as fragments of shell. Mr. Pritchard notices an instance of a meteorite reaching the earth perfectly cold, which must, therefore, have subsided rather than fallen; and he tells us of the recent discovery (without applying it), that one at least of the rings of Saturn is not opaque, but appears, under powerful telescopes, as if composed of a cloud of dust, through which the body of the planet may be discerned. If so, may we not suppose that the earth has also its ring of "cosmical dust;" and even indulge the conjecture that it is the gradual concentration and consolidation of rings composed of elementary corpuscles, drawn from the infinite stores of space, that form the primitive crusts of worlds, and sustain and augment their volume?

I throw out these ideas in the hope that the earth's possible local connection with meteoric streams may receive discussion before we quite take for granted the theory, beginning to be accepted, of their planetary orbit. We know at present nothing of the electric conditions of the upper strata of the earth's atmosphere, and meteorites, which may be, in part, the product of such electric conditions, should not, clearly, be treated as Lilliputian planets without considering whether they may not belong to the humbler rank of minute satellites. To determine, however, the one theory or the other,* we want better data for the true direction of the meteoric orbit than have yet been collected. A friend in the south of France writes to me that the November stream was seen at Marseilles, but not—where it was equally looked for—at the Observatory of Nice. This would indicate that the stream was a narrow one, and that its course was more directly north than that of the angle I have referred to. I noticed myself, on the morning of the 14th, half an hour after midnight, two meteors racing together from Leo Minor, in a line parallel with the pointers of Ursa Major, towards λ in Draco; and for the apparent divergencies in the course of others east and west of the Greenwich meridian, we want corrections for the earth's diurnal motion.

I conclude by remarking that we want, also, intelligence from the other side of the globe; especially from the Friendly Isles and New Zealand; where, if the meteors were moving in a satellite orbit, and were there visible, they would be seen not as *ascending* from southern constellations, but as descending from northern to southern.

Your obedient servant,

Fairseat, Wrotham: W. E. HICKSON.*

Feb. 15, 1867.

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* The satellite theory of meteors is not new. In the *Comptes Rendus* of the French Academy, for Oct. 1846 and Aug. 1847, were given the observations and calculations of M. Petit, director of the Observatory of Toulouse, tending to the conclusion of a meteoric mass, of considerable magnitude, moving in a satellite orbit about 5,000 miles from the surface, or twenty-six times nearer than the moon.

THE RECENT NOVEMBER METEORS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—It would be manifest to all who witnessed the meteors which passed through the earth's atmosphere on the evening of the 13th and the morning of the 14th of November 1866, that they all radiated from one point in the heavens—viz. from below γ in Leo Major; that they appeared to travel in all directions from Leo to the western, northern, southern, and eastern horizons; and that none of the meteors appeared within an area of 5° in diameter, which formed the focus of emission in Leo Major.

On the belt, zone, or solid cluster theories, I confess myself unable to understand why none of the meteors were visible exactly in the focus in Leo, and why many of the meteors did not strike the earth.

These difficulties have led me to develope the following theory, which, whether true or false, certainly has the merit of novelty, and also that of accounting, without apparent hitch or flaw, for the phenomena seen on the eventful morning of the 14th November.

Before introducing the hypothesis which I am about to advance, I beg to direct the attention of your readers to the following acknowledged facts in astronomy:—1. All the large solid bodies in the solar system revolve on their axes.—2. Some of the planets have zones, or rings, which revolve on their axes round the planets—such, for example, as the rings of Saturn.—3. The zodiacal light, which is supposed to consist of countless multitudes of meteoric stones, probably revolves on its axis, having the Sun for its centre, and hence its spherical form.—4. The inner ring of Saturn is believed to be not solid, but to consist of a large number of fragments or stones.—5. Whenever two large bodies—such, for example, as stars—are in close relationship to each other, they obey a law similar to that which obtains between the Sun and its satellites; the Sun not being in a fixed centre, but being moved by the action of every planet within the sphere of its influence.—6. Nebulæ are seen in the form of circles, and many have the appearance of revolving in such forms.

These and many other facts which might be adduced corroborate the hypothesis I am about to propound, as to the form of the zone, belt, or cluster of meteors which is supposed to revolve round the Sun, in an orbit of similar dimensions to that of the earth, and which cuts the plane of the earth's orbit during the month of November at intervals of 33 years, while the earth is in the same locality. The phenomena witnessed on the morning of the 14th, I believe, are incompatible with any theory yet suggested, and the following seems to me to be a probable hypothesis.

The meteors which travel round the Sun at a distance equal to that of the earth, and inclined to the plane of the earth's orbit, are not in the form of a flat ring or belt extending partially or entirely round the Sun—are not a belt at all, but probably have the form of an irregular cylinder or perforated cluster, through the centre or opening in which the earth passes as the cylinder and earth meet in space. The length of the cylinder, tube, or tunnel through which the earth passes, may be approximately ascertained by the length of time the meteoric shower remains prominently visible—say for two hours.

The earth travels from W. to E. at the rate of nearly 20 miles per second; 20 × 60 = 1200 miles per minute; 1,200 × 60 = 72,000 miles per hour; × 2 = 144,000 miles, the distance travelled by the earth in two hours.

The meteors travel from E. to W., or in the opposite direction, at a similar rate—therefore they pass over 144,000 miles in two hours; and the two opposite motions added together = 288,000 miles, which is the probable length of the meteoric cylinder or tunnel. The diameter of the tunnel may also be obtained in the following manner. The diameter of the earth is nearly 8,000 miles; if the cylinder, therefore, were not 8,000 miles in diameter, all the meteors within that area would fall upon the earth, or be dispersed in its atmosphere; and we have not any example of November meteors striking the earth; the tube, therefore, is more than 8,000 miles in diameter. Its probable diameter is 8,200 miles, as the measured heights of meteors seen in November is between 100 and 200 miles. The brilliant meteor which I saw in Cepheus at 2.42 was visible by Professor Grant in Glasgow at the same hour, and was by him projected on Ursa Major; the height of the meteor, therefore, was between 100 and 200 miles.

Seeing that no meteors were visible in or near the focus or radiant point in Leo; seeing that the earth was travelling exactly in that direction; and seeing that the meteors radiated in all directions, E., W., N., S., without appearing to cross or touch the focus, it is probable that the earth does not pass through a belt, but through a tube of meteors, and that those meteors which form the inner lining of the tube skirt and pass through the upper regions of the earth's atmosphere, and become intensely bright and distinctly visible by the great heat developed during their passage through the atmosphere, at a speed equivalent to forty miles per second.

It would be impossible for a long belt of stones to revolve round the sun for any length of time as a belt, unless the stones constituting it had a rotatory as well as an orbital motion. It is probable, therefore, that they have a proper rotatory motion among themselves; and if they have a motion round their longer axis, it is only a legitimate inference that the cluster is hollow. Certainly the phenomena attending the November meteoric exhibition appear inexplicable except on the theory that the meteors do not exist in the direct line of the earth's motion, and do exist in the line of the motion of the earth's atmosphere, and that the earth moves through the open centre of the meteoric cluster. If the meteoric cluster were not in the first instance a cylinder or cluster with a hole through it, it would, after a single passage of the earth through its centre, assume that form, as all the meteors that were in the direct line of the earth's motion would either be dissipated in its atmosphere or fall upon its surface.

I am, your obedient servant,

T. P. BARKAS.

Newcastle-upon-Tyne:
Dec. 15, 1866.

CELESTIAL PHOTOGRAPHY.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—There is a mode of applying photography to celestial objects, which long since occurred to me, but which, obvious as it appears, I have not seen referred to as having been put to the test of practice, in any paper on the subject which I have had an opportunity of reading. It is, of course, possible that the method may have been tried and found unsuccessful in the present state of the photographic art; nevertheless, if you will allow a short description of it to appear in the *Astronomical Register*, it may lead to a discussion which may prove not uninteresting.

In making out the most delicate details of celestial objects—such, for instance, as Mars and Saturn—however perfect may be the telescope, we encounter two difficulties, one arising from atmospheric causes, the other from the great loss of light when deep eye-pieces are used. The former of these difficulties can, of course, only be overcome by taking advantage of the most favourable state of the air for making observations; but the latter would seem to be capable of removal if photographs of such objects as those above mentioned could be obtained of sufficient sharpness and intensity to bear examination in the microscope under *proper artificial illumination.* Suppose, for example, a good negative, on a fine smooth surface of collodion, were taken of Mars in his present favourable situation, and viewed by the aid of a Wenham's parabolic illuminator, with a *dark ground*: this would show as a positive, and by a proper degree of illumination might be made to exhibit every marking, however faint, impressed by the planet's light upon the sensitive surface.

The conditions of success would appear to be these: first, fineness and smoothness of the collodion surface, so as to bear magnifying in the microscope; secondly, sharpness and intensity of the photographic image. For this latter an object-glass of large aperture would be required, probably assisted by an achromatic convex lens to concentrate and intensify the image, the actual size of which does not seem of great importance for the purpose in view.

Obviously the principle of the method is simply to develope the photographic details by means of artificial illumination, which could be applied in any required degree; and it amounts, in fact, merely to treating a celestial photograph in the same manner as the microscopic photographs, many of which form such beautiful objects. It is quite different from making an enlarged image on paper of a photograph.

I observe that Mr. Brothers, in his interesting paper on Celestial Photography, printed in the third volume of the *Astronomical Register*, page 35, speaks of some negatives of the moon, made by Mr. Dancer, of such excellence that they would bear examination under the microscope with a 3-inch objective. However, for reasons given in that paper, I do not think the method I suggest would be applicable to photographs of the *whole* lunar surface, though it might succeed with those of certain portions of it taken through a small diaphragm.

I regret that I am not in possession of the necessary appliances for giving the method a fair trial; it is possible, however, that some of your readers who have adequate means might think it worth while to ascertain what result can be obtained; or if any astronomers have made the attempt unsuccessfully, they would perhaps describe the process employed and the cause of its failure. I am, Sir, yours faithfully,

Jan. 14, 1867. R. C. H.

SUSPECTED VARIABLE STARS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—In Mädler's "PopuläreAstronomie" there is given a list of stars which are supposed to have varied in brightness. I cite below this list, as near as may be in the author's own words (translated), and should be glad to learn whether any of your readers can throw any and, if so, what light upon the statements made:—

4 Canis Majoris is brighter than it was.
10 Canis Majoris is brighter than it was.
14 Orionis, formerly below magnitude 6, is now above it.
18 Orionis has decreased in brightness.
25 Orionis has certainly decreased in brightness.
Perhaps 112 Tauri and 70 have done the same.

21 Orionis has become somewhat brighter.

30 Orionis has become sensibly brighter.

ε Arietis. The component A seems to vary between magnitudes 4 and 6.

γ Virginis is said to be variable, but Mädler makes no specific remarks.

191 Virginis. A and B sometimes are equal; at others they differ by ½ a magnitude.

ζ Boötis. A varies from magnitude 3 to magnitude 4.

1 Coronæ. In 1823 Struve found A and B equal; 5 years later they were of magnitudes 5½ and 6½ of his scale.

17 Cancri. Sir W. Herschel found the more southern star to be the larger one. Struve in 1829 found this star (which by orbital motion had become the northern) to be the larger by 1½ or 2 magnitudes. In 1832 and following years the difference did not exceed 1 magnitude, and sometimes was only ½ a magnitude. In 1850, Argelander considered both stars to be equal. Seemingly it was B that had undergone the change and had become more bright.

π Arietis. According to Struve, A varies between magnitudes 4–6, and B between magnitudes 7½–9.

38 Geminorum. A varies from 4–5, B does not change.

Anonyma. R.A. 20h 34m. Decl. + 12° 6′. A double star, of which sometimes one component and sometimes the other is the brighter.

ι Cancri. A is uniformly of magnitude 4 or 4½, but B varies from 5½–7.

Want of time has prevented me instituting any enquiries myself as to the above stars.

Your obedient servant,
GEORGE F. CHAMBERS.

Dethen Grange, Sydenham:
Feb. 2, 1867.

BRIEF CORRESPONDENCE.

ICE AT THE POLES.—May I be allowed to give "F." (page 43) some little information as to the question of periodical deluges? If he will consult—at the British Museum Library, of course—a book named *Périodicité des grands déluges*, by Lehon and Adhemar, published at Brussels some eight or ten years ago, I dare say he will find there all he requires. I am not aware that the theory propounded in that work, for the first time, I believe, has been much discussed, though it seems pretty generally accepted in France. "F." might also have a better chance of information by applying to a *Geological* Society or periodical than to an Astronomical one.

ENDYMION PIERAGGI.

Paris: Feb. 14, 1867.

IN reply to the enquiry of F. in the last number of the *Register*, I remember reading the statement to which he refers; and I submitted it to one of the most accomplished of living philosophers. I am sorry that I cannot lay my hand upon his reply; but it expressed his reasons for disapproving the deluge-theory put forward.

ATHLETA.

OBSERVATORY STATISTICS.—May I be permitted to ask what has been done, or is to be done, with the statistical returns collected from English astronomers through your agency some year or more ago? Are they, or any abstract of them, to be published? If so, when and by whom? or have they been consigned to the waste-paper basket of yourself or the laird of Cranford? G. F. C.

[If G. F. C. will refer to page 91 of the *Register*, Vol. IV., he will find a short abstract of the returns received by the editor, which were handed to Mr. De la Rue, in accordance with whose wish they were collected, and in whose hands, as far as we have any information, they still remain.—ED.]

CELESTIAL LONGITUDE.—In answer to "T. W.," there are probably tables constructed to facilitate the reduction of longitude and latitude to right ascension and declination, and *vice versa*, but I cannot indicate them. Perhaps a good celestial globe would answer the purpose when a rough approximation only is wanted. G. J. W.

MR. HOWELL'S TELESCOPE.—In his paper on "Celestial Photography," in the *Astronomical Register*, Vol. IV. p. 36, Mr. Brothers says that the aperture of the above was 8½ inches, and the focal length 11 feet. I am told this is a mistake; that the aperture was only 6 inches. What are the facts? F. R. A. S.

[We had the pleasure of paying several visits to Mr. Howell's observatory at Brighton, at Christmas last. The equatoreal is by Cooke of York. Aperture 6 inches, and focal length about 8 feet. The observatory and instruments were in excellent order.—ED.]

PERFORMANCE OF OBJECT GLASSES.—If "A Subscriber" refers to page 196, Vol. I. of the *Astronomical Register*, he will find that Mr. Dawes divided γ^2 Andromedæ with A. Clark's 8¼-in. refractor; and Mr. Lowe writes me word (Jan. 1) that he now sees it divided with the same instrument. D. T. K.

ALCOR.—Humboldt says that Alcor could rarely be seen with the naked eye in Europe. Guilleuim speaks of its present visibility as if he meant to suggest that it was variable. Can any of your readers throw light on this matter? G. F. C.

MR. WEBB'S "CELESTIAL OBJECTS."—Sir,—With reference to a query signed G. T. F., printed in the January number of your valuable journal, I am directed by Mr. W. Longman to present his compliments to you, and to inform you that an enlarged and much-improved edition of WEBB'S *Celestial Objects for Common Telescopes* is preparing for publication. —Faithfully yours, for Longmans & Co., F. SYKES.

Finding the Planets.—May I make a suggestion for the benefit of those who, like myself, have no telescopes (for I cannot call mine one), and are not scientific enough to find objects when only the R.A. is given? It is this—will you be kind enough in your monthly lists of the planets to inform us in what constellation, or in what quarter of the heavens, they are situated, so that I and others like myself can readily find them? I am very anxious to see Mercury with my glass, and your notice of the Planets for February says it (Mercury) can be seen for one hour after sunset at the end of the month. Will it be to the right of, or to the left of, or straight above the sun? Will you please act on this suggestion in your March number?
John Cook.

[If our correspondent's telescope is small, and not equatorially mounted, he will not readily "pick up" Mercury with it. We have, however, indicated the quarter of the heavens in which to look for the planet, by giving its Right Ascension and Declination. From any ephemeris or almanac (say Hannay's, price 8*d.*) the place of Mercury and that of the Sun for the day of observation can be found. If these are marked on a star map or celestial globe, the relative position of the planet with regard to the Sun will be immediately seen. It must be remembered that the tables in the *Register* are not intended to supersede the necessity for almanacs, maps, or other means; their purpose is to point out to the amateur the objects which are to be seen at particular times, and to warn the observer of occurrences about to take place. If every difficulty were removed from the path of the tyro, his zest in the pursuit of the science would be very much diminished. —Ed.]

Astronomical Pronunciation.—Amateurs in astronomy and others are often at a loss for the proper pronunciation of many astronomical terms, names of celestial objects, and the names of eminent astronomers both living and dead. Would it be desirable to insert in the *Register* a short pronouncing vocabulary of such names, &c., in alphabetical order?
F. B.

[Our correspondent's suggestion is a very good one, and we hereby ask for the co-operation of our subscribers in sending to us any names or words about which hesitation exists. We will collect them, and, with the assistance of the more learned of our correspondents, endeavour to give an accepted reading of them.—Ed.]

Longitude from Occultations.—The longitude cannot be deduced by an occultation without calculations to find the large effect of the moon's parallax. One method is given, illustrated by examples, in Loomis's *Practical Astronomy*, to which I would refer Mr. W. Locke. If he should find himself at a loss, and cannot apply to a friend to assist him, I could reduce the observation for him—for which his longitude and latitude, estimated as near as possible, must be furnished; but if tolerably familiar with trigonometry, I think he will find Loomis's work sufficiently explicit.
G. J. W.

ASTRONOMICAL OCCURRENCES FOR MARCH 1867.

DATE		Principal Occurrences h. m.		Jupiter's Satellites	h. m. s.	Meridian Passage h. m.
Fri	1	 23 36	Sidereal Time at Mean Noon, 22 35 17·4 Conjunction of Moon and Venus, 2° 12′ S.			Mars. — 8 16·5
Sat	2		Meridian passage of the Sun, 12m. 25s. after Mean Noon	1st Tr. I.	18 22	8 13·1
Sun	3					8 9·8
Mon	4	3 29	Conjunction of Moon and Jupiter, 3° 36′ S.			8 6·6
Tues	5	21 38	● New Moon			8 3·3
Wed	6		Eclipse of the Sun; begins at 8h. 17m. A.M., ends 10h. 52m. (see last number)	4th Sh. I.	18 25	8 0·1
Thur	7	6 11	Conjunction of Moon and Mercury, 2° 37′ N.			7 57·0
Fri	8					7 53·9
Sat	9	9 19 9 48	Near approach of Moon to ξ¹ Ceti (4½) Greatest easterly elongation of Mercury, 18° 13′	3rd Tr. E.	17 49	7 50·8
Sun	10					7 47·8
Mon	11					Moon. — 4 34·1
Tues	12	20 47	☽ Moon's First Quarter			5 30·7
Wed	13	17 24	Conjunction of Moon and Uranus, 5° 31′ N.			6 28·2
Thur	14	11 37 14 48	Conjunction of Moon and Mars, 7° 57′ N. Occultation, disappearance of λ Geminorum (4½)			7 25·9
Fri	15	20 46	Conjunction of Jupiter and μ Capricorni 0° 2′ N.			8 22·8

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Sat	16	10 3	Sidereal Time at Mean Noon, 23 34 25·6 Conjunction of Jupiter and μ Capricorni, 0m·6 W.			Moon. — 9 17·9
Sun	17	9 26	Near approach of Moon to B.A.C. 3398 (6)			10 11·0
Mon	18					11 1·9
Tues	19	20 55	Meridian passage of the Sun, 8m. 1s. after Mean Noon ○ Full Moon			11 51·0
Wed	20					Mars — 7 19·4
Thur	21					7 16·8
Fri	22	9 28 10 17	Occultation of κ Virginis (4½) Reappearance of ditto			7 14·1
Sat	23			4th Sh. E.	17 31	7 11·5
Sun	24	3 24 14 52 16 16	Conjunction of Moon and Saturn, 2° 15′ S. Occultation of 49 Libræ(5½) Reappearance of ditto			7 9·0
Mon	25					7 6·4
Tues	26	10 29	Inferior conjunction of Mercury			7 3·9
Wed	27	14 53 15 40 15 21 16 42 19 46	Occultation of B.A.C. 6287 (6) Reappearance of ditto Occultation of B.A.C. 6292 (6) Reappearance of ditto ☾ Moon's Last Quarter	3rd Oc. R.	16 44	7 1·4
Thur	28	15 42 16 33 16 4	Occultation of ρ^2 Sagittarii (5½) Reappearance of ditto Near approach of Moon to ρ^1 Sagittarii (4)			6 58·9
Fri	29					6 56·4
Sat	30					6 54·0
Sun	31	8 34 23 54	Conjunction of Jupiter and Venus, 0° 43′ N. Conjunction of Moon and Jupiter, 3° 10′ S.			6 51·6

THE PLANETS FOR MARCH.

Mercury sets about an hour and a half after the Sun during the first half of the month, reaching his greatest eastern elongation on the 9th, and arriving at inferior conjunction on the 26th.

		h.	m.	s.			°	′		
1st	R.A.	23	42	26	Decl.	—	1	49	Diameter	6″·0
15th	„	0	34	23	„	+	7	0	„	8″·4

Venus may still be seen in the morning before sunrise.

1st	R.A.	19	41	39	Decl.	—	18	57½	Diameter	21″·8
15th	„	20	44	50	„		16	50½	„	19″·6

Illuminated portion of the disc of Venus, 0·605.

Mars sets about five o'clock in the morning at the beginning, and about half-past three at the end, of the month, and is therefore well fixed for observation during the night.

1st	R.A.	6	52	55	Decl.	+	26	16½	Diameter	12″·0
15th	„	7	4	35	„		25	37½	„	10″·6

Illuminated portion of the disc of Mars, 0·913.

Jupiter rises about half-past six in the morning at the beginning of March, and about half-past four at the end of the month.

1st	R.A.	21	32	50	Decl.	—	15	17
15th	„	21	45	19	„		14	16½

Saturn rises shortly after midnight at the beginning of the month.

1st	R.A.	15	29	17	Decl.	—	16	34	Diameter	15″·8
15th	„	15	28	53	„		16	30	„	16″·2

Dimensions of Ring—Outer Major Axis, 40″·0; Outer Minor Axis, 16″·0.

Uranus is still favourably placed for observation.

6th	R.A.	6	19	7	Decl.	+	23	42	Diameter	4″·0
18th	„	6	19	5	„		23	42	„	4″·0

The minor planet **Juno** arrives at opposition this month.

2nd	R.A.	10	58·8	Decl.	+	3	36
12th	„	10	50·7	„		5	15

THE SUN'S DISTANCE.—The following advertisement, which appears in the *Times* of February 11, 1867, may be interesting to such of our readers as are "astronomical heretics:"—"Fact *versus* Fiction.—1st, The Sun's Distance; 2nd, The Stability of the Earth.—Fact 1st. I have for years observed, at noon, when 50 degrees north of the sun's perpendicular, the shadow of any perpendicular substance is as long on a plane base as the substance is high. This fact clearly proves the distance of the sun is not as many thousand miles as modern tuition says 'tis millions. I hereby challenge the modern scientific to show how it is possible for such amount of shadow to appear, if the sun's distance was more than six times the earth's diameter, the earth being a globe. Fact 2. It is a well-known fact, when an eclipse of the sun occurs, the dark body of the moon appears to the eye of an observer to pass over the sun's disc from west to east. This fact proves that the earth does not turn daily before the sun. I challenge the aforenamed to show the possibility of the earth's turning once in 24 hours. The moon travelling round the earth only once in 29 days, the sun stationary, and the eclipse not to appear to an observer to pass from east to west before the sun.—J. Welsford, 18 High Street, Plymouth, Devonshire."

ANCIENT LUNAR ECLIPSES.—In the last volume of the "Cuneiform Inscriptions of Western Asia," published by the British Museum, the late Dr. Hincks met with three statements:—"In the month Nisan, on the fourteenth day, the moon was eclipsed." "In the month Tisri, the moon was eclipsed." "In the month Sabat, the moon was eclipsed." To the second of these statements, a sentence is added in the original, explaining that "the moon emerged from the shadow while the sun was rising." After an elaborate calculation, Dr. Hincks satisfied himself that the three eclipses had been seen, the second on the 13th of September 701 B.C. Dr. H. adds—"According to Hansen's Tables, the moon would be very far, perhaps half a degree, beyond the place which would allow the phenomenon to appear in the longitude of Nineveh. If then it be a fact that it was observed there, it furnishes astronomers with a most important datum for correcting the lunar tables." Dr. Hincks considers that all the observations of these eclipses may be reduced to harmony with calculations, by adopting the values of certain specified co-efficients of Professor Adams, in conjunction with a small correction, acting in the opposite direction, due to the retardation of the diurnal motion, caused by the tides.

INSTRUMENTS, &c. FOR SALE.

These Notices, which are restricted to *two lines* each, are inserted free of charge to subscribers: applications respecting prices and other particulars to be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—For Advertisements with prices and more complete details, a small charge will be made.

N.B.—It is particularly requested that we may be informed when instruments are disposed of, in order that the notice may be withdrawn, and fruitless applications prevented.

Achromatic Refractor, 6·4 in. ap. 8½ ft. focus, by *Merz,* Equatorial and clockwork by *Troughton & Simms.* [73]

Achromatic Refractor, 4 in. ap. 5 ft. focus, by *Dollond;* equatorially mounted. Powers up to 400. [87]

Dialyte Telescope, 4¼ in. ap. 5 ft. focus, price very low. [88]

Gregorian Reflector, 4¾ in. ap. 2 ft. focus, by *Dollond,* 4 powers, 50 to 200, finder, &c., on brass table stand. [63]

Achromatic Object-Glass, 4⅛ in. ap. 62 in. focus, by *Slugg,* with brass cap and receiving cell, for mounting on tube. [85]

Newtonian Metal Speculum, 8 in. ap. first-class quality. [77]

Transit Instrument, 3¾ in. ap. 5 ft. focus, Ys fitted with agates for mounting on stone piers. [29]

Equatorial Stand, for a 5 or 6 ft. telescope: 13 in. circles, divided on silver, to 10″ of space and 4s. of time.—Has never been used. [55]

Varley Stand, improved, rackwork movements, for a telescope of 5 or 6 ft. focus: on circular turn-table, to point in any direction. [16]

Polar Axis, of mahogany, 7 ft. long, adapted for a 4 ft. telescope, with 12 in. circles, reading to minutes. [56]

Speculum Grinding Apparatus, capable of working a 7 ft. speculum: with tube and fittings for a 9 in. Newtonian. [57]

Electrical Machine, powerful, 18 inch ebonite plate, by *Silver & Co.,* with brass conductor. [93]

Electrical Machine, plate 12 inches in diameter, in case complete. Price low. [90]

Recreative Science: and the first three volumes of the **Photographic Journal:** price very low. [30]

Lardner's Astronomy, latest edition; and **Hind's Illustrated London Astronomy.** Both clean copies. The two, 4*s.* 6*d.* [96]

INSTRUMENTS, &c. WANTED.

Equatorial Telescope, about 6 in. aperture, with driving clock and circles; price moderate. [89]

Astronomical Clock, not very first-class; price low. [65]

Gregorian Reflector, second-hand, not less than 9 in. diameter; or a dumpy **Newtonian**, not over 5 ft. focus, without stand. [95]

Equatorial Stand, for a 5 ft. Refractor: graduated circles. [35]

Transit Instrument, 2 in. ap. 18 or 24 in. focus. [71]

Monthly Notices of the Royal Astronomical Society, Vol. 3. [26]

Monthly Notices: Vols. 3, 4, 5, and 7. [82]

Bartholomew Prescot on the **Universe**, published 1823: a copy wanted, in good condition. [84]

SPECTRUM ANALYSIS.—Mr. Huggins has just published (price 5*s*.; W. Ladd), "Results of Spectrum Analysis, applied to the Heavenly Bodies," with appendix and eighteen photographs.

THE GREAT PYRAMID.—Messrs. Edmonston & Douglas, Edinburgh, will shortly publish, under the following title, "Life and Work at the Great Pyramid, during the Months of January, February, March, and April, A.D. 1865; with a Discussion of the Facts Ascertained," by C. Piazzi Smyth, F.R.SS., L. and E., Astronomer-Royal for Scotland. In three vols., each 500 pages. Vol. I. Journal of Proceedings. Vol. II. Numerical Observations. Vol. III. Discussion of Results.

LIST OF SUBSCRIBERS—Names received since our last number.

Pearson, A., Esq., Derwent School, Medowsley, *viâ* Gateshead.
Ryley, H. B., Esq., Chapel House, Deritend, Birmingham.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To March 1866.
Ingall, H.

To October 1866.
Coulcher, W. M. B.

To December 1866.
Clermont, Lord.
Harker, J. W.
Landell, W.
Redpath, H. S.
Vallance, P.
Yeates & Son.

To March 1867.
Metcalf, Rev. W. R.
Pearson, A.

To June 1867.
Morton, Rev. J.
Smithers, H. W.

To September 1867.
Lancaster, W. L.

To December 1867.
Adams, S.
Bowman, E.
Gill, D.
Hibbert, G.
Knott, G.
Lancaster, J. L.
Parnell, J.

NOTICES TO CORRESPONDENTS.

Several communications are deferred for want of space.

ERRATA.—In No. 49, p. 22, The position of the radiant point of the meteors, by Lieut. Tupman, *should be* R.A. 149° Dec. N. 23°.

In No. 50, p. 33, line 3 from bottom, *read* "marked γ on Beer and Mädler's large map. Its diameter is to my eye *less* than *that* of Sulpicius Gallus."

In No. 50, p. 25, in Names of Fellows elected, *for* Thomas Warren, Esq., *read* Thomas Warner, Esq.

Received—*Descriptive Astronomy*, by G. F. Chambers, Esq.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Stamford Villa, Downs Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 52. APRIL. 1867.

ROYAL ASTRONOMICAL SOCIETY.

Fifth Meeting, March 8, 1867.

The Rev. C. Pritchard, M.A., F.R.S., *President*, in the Chair.

Secretaries—Mr. Stone and Mr. Huggins.

THE President said he could not take his place again in the chair without thanking the members for the renewed mark of their confidence, as shown by his re-election. They might rely upon his unceasing exertions for the good of the Society; and he confidently trusted to leave it, at the expiration of his term of office, at least no worse than when he began. He also congratulated the Society on having Mr. Huggins as one of its Secretaries. The President and Council were important; but, after all, the Secretaries were the executive; and now he felt that on either side of him he could look for the best information and the most cordial feeling. Indeed, the President and Secretaries might be considered as one and the same person. He also announced that, with a view to avoid interruption, the ballot would in future be deferred till after the papers had been read.

The minutes of the last ordinary meeting were read and confirmed.

Sixty presents were announced, and the thanks of the Society voted to the respective donors. Among them were four valuable works, presented by Sir John Lubbock, Bart.—viz. Sir J. Herschel's 'Cape Observations,' Bagay's 'Astronomical Tables,' Kirchhoff 'On the Solar Spectrum' (translated by Roscoe), and Laplace's 'Précis de l'Histoire de l'Astronomie.'

Alexander S. Herschel, Esq., B.A., and Malcolm M'Neil Walker, Esq., were balloted for and duly elected Fellows of the Society.

F. C. Penrose, Esq., John Morgan, Esq., Francis Bowen, Esq., and James Carpenter, Esq., were elected at the last meeting.

The following papers were read:—

On a perfectly-formed Object Glass deduced from a Critical Analysis of the Secondary Spectrum: by Mr. Dawson.

It has been supposed that a telescope consisting only of glass lenses cannot be completely corrected; but the author stated he had found out a method of doing so without using any other materials, or altering the composition of the usual flint and crown glass. By means of a diagram he showed the constitution of the secondary spectrum, which is produced by the want of coincidence of the middle portions of the spectrum when the extremities are made to meet; and thus, although the red and blue rays do not overlap, yet the intermediate ones, which are much brighter and more important, do not correct one another, and thus the most luminous parts are left imperfect. If the lenses be altered so as to get the brightest rays coincident, some outstanding colour is left, and this is generally aimed at; and a little residual blue exists, when the glass is said to be over-corrected. Many endeavours have been made to conquer this difficulty, but it has never been completely effected. It will be accomplished if the blue can be contracted and the red expanded; and this may be done by refraction, so as to cause the blue rays to fall more perpendicularly, and the red less. To effect this, the flint lens must be drawn back a proper distance behind the crown, so as to cause the rays to fall at the desired inclination, when the red rays will fall at a lower angle, and be more refracted; and the blue, being nearer the axis, will have a greater angle of incidence and less refraction. Having satisfied himself of the principle, the author worked it out in practice, and made a 3½-inch object glass of 5-feet focus. In drawing back the concave flint lens, he found the focal length much increased; and he therefore added a convex crown lens to it, and ultimately arrived at a result in which, if the secondary spectrum was not got rid of, it was at least not evident to ordinary tests. Mr. Dawson then described how he tested the glass, and was able to distinguish the secondary spectrum from errors of figure, and that by bringing the glass during its working to successive figures, giving different kinds of spherical aberration, he demonstrated the success of his correction, although the glass, for other reasons, did not turn out a particularly good one.

Mr. Stone explained the mathematical expression for the theory of achromatism, and showed that by Mr. Dawson's plan the correction might be closely approximated to, but thought there were practical difficulties in carrying it out.

Mr. Simms stated that some years ago (about 12), having to make an object glass of 4½ inches aperture, and only 4 feet focal length, for Mr. Carrington, he found the secondary spectrum so strong, that to diminish it he separated the lenses; and after much labour he produced a pretty good correction of the aberration; but the process was so troublesome that he had never tried it again.

The President: The glasses which have been described are hardly large enough to test the principle. In the dialyte telescopes, made with success by Plössl of Vienna, the back lens is put at a great distance from the front. I am always sorry to hear any person speak of correcting the spectrum absolutely. Of course, approximation to a great extent can be effected, but absolute correction is physically impossible. Any process which must be confined to 3 or 4 inches is useless; we must have 10 or 12-inch glasses, and we shall then soon see if we have got rid of the secondary spectrum. The diameter of the circle of chromatic aberration is about 1-60th of the diameter of the object glass, and the residual spectrum of a corrected glass is 1-50th of the former aberration; we may bring three rays together, but not all.

Mr. Simms: I remember a case mentioned by Mr. Grove, in which, having a very mediocre telescope, he inserted a common spectacle glass and made a very decent instrument of it.

Mr. Stone: In the object glass you made, I understand you did at last succeed in getting a more perfect achromatism?

Mr. Simms: Yes, but there was a little outstanding spectrum. Boscovich has gone deeply into this matter, and says three substances must be used to ensure achromatism.

The President: I hope we shall not hear any more of perfect achromatism.

Mr. Grove: I am exceedingly anxious to hear the result of Mr. Wray's interposition of resinous substances between the lenses. As to my altering an old telescope, of course the addition might have made it worse; but it was an over-corrected glass, and the long focus spectacle lens improved it. I have worked at this subject off and on for many years, and as long ago as 1853 sent a paper here in which I advocated a cement of clear resin and castor-oil. Dr. Blair used a fluid lens, but this will evaporate. Others have tried other things but all fail in time. I have written a short paper on the subject in the "Philosophical Magazine" for this month. Oil of cassia stands at the head of the resinous substances that may be used, but for the foregoing reasons a liquid is undesirable. The arrangement necessary is a convex crown lens; then the cement forming a meniscus between it and the flint concave. I have tried Canada balsam; but in three or four years it cracks and gives way; other bodies, such as copal varnish, become full of clouds of little bubbles. I then had recourse to solid substances, which are introduced when fused, and solidify. Very clear resin and castor-oil answered best with me, and glasses thus cemented are quite permanent. A thickness of 1-8th or even

1-6th of an inch is entirely transparent. The resin should be filtered by putting it in a blotting paper cone in a retort-stand without any glass funnel, and placing it near the fire, when it will melt and run through beautifully clear. The proportions I found by a tentative process. I thus got a tough cement and a very fair result, for with a 3-inch glass the secondary spectrum was practically *nil*. It is, we know, not theoretically correct, as there must be a series of overlappings, but it is an excellent approximation. Mr. Wray's patent bringing the subject before us, caused me to write the paper I have referred to this month, especially as, in my address to the British Association at Nottingham, I suggested oily or resinous substances for the purpose; but I do not think Mr. Wray grapples with the difficulties of the operation. If a liquid be used, and alters in time, it is true we may refill the cell, but in practice the glass is never the same again, and this difficulty I believe stopped Dr. Blair. Another thing is that liquids are very apt to flow to one side and form an irregular wedge, which produces tails and irregular figures on the stars. This is excessively difficult to avoid, but with fused cements it is done by keeping a steady pressure on the edge till the glasses are fixed. I think there is some prospect of success in this matter now. Mr. Cooke, whom I have urged to take up the subject, thinks not,—he believes that temperature will disturb these bodies, and that nothing but a substance like glass can be used for the correction, and no such substance is known.

The President: Why not use reflectors?—they produce no dispersion.

Mr. Grove: I do not believe in the possibility of getting a perfectly parabolic form. I think this more difficult than correcting a refractor, and that the latter is more likely to be a success.

On the Total Eclipse of the Sun of August 1868: by Major Tennant.

In a short note printed in the "Monthly Notices" for January, the author called attention to this important eclipse, and promised to give the necessary data for observers. It is very rare to find an eclipse happening under such favourable circumstances, as at the time the Moon will be within 6 hours of Perigee, and the distance of the centres of the Sun and Moon will be only 2′·75. They will both be high—the parallax will be at its least and the motion at the slowest. The effect will be, where the eclipse is central at noon, that it will last 6¾ minutes. The eclipse begins on the West Coast of India in latitude 16° 35′ N., crosses Hindostan, and leaves it a little above Masulipatam, traverses the Bay of Bengal, the Andaman Islands, the Malay Peninsula, and passes off by Borneo and Torres Straits. The shadow will be 143 miles broad. On the west side of India, on account of the proximity of the SW.

monsoon, the weather will be almost certainly bad; but on the eastern coast, in the deltas of the Godavery and Kisnia, there is every probability of very fine weather, and the eclipse will last 5¾ minutes. Major Tennant had calculated the exact line of the eclipse, laid it down on a map, with the times at many places, and formulæ for finding the time elsewhere. The eclipse should be most interesting to English observers. The one in 1860 settled that the red flames belong to the Sun, but we have still much to learn about them. Are they connected with the faculæ or spots? If they are seen at all, we are sure to ascertain something fresh as to them. The matter should be seen about at once, as it would be grievous for such a fine eclipse to pass without observation.—The author was happy to say the Council of the Society had taken it up. In his opinion there should be two observing parties—one at Guntoor, near the East coast, and one on the other side of a chain of hills there, and it was then hardly possible that both stations would be obscured by clouds at once.

The President: The Council have taken Major Tennant's paper into their most serious consideration, and as far as their influence extends have resolved to do their very best to impress upon the Government to avail itself of the opportunity. So far as the Council is concerned, the action will commence to-morrow; and I cannot believe that a cost of three or four thousand pounds will stand in the way of settling a question which can only be decided on our own dominions, except as to one French settlement. This eclipse will last nearly 6 minutes—that of 1860 was only 3 minutes; so that the time for observing is much greater. In 1860, an hour or two earlier or later would have prevented any one seeing it; and even as it was, a short distance made all the difference in the weather. Although I had to adjust my telescope under an umbrella, the weather cleared at the right moment, and I saw the eclipse; but Mr. Vignolles, who went to the top of a mountain, did not. He was on one side of my station; and Dr. Whewell, 6 miles the other side, also lost it. It is a question of a cloudless sky for a few minutes, and the multiplication of observers is therefore necessary.

Mr. De la Rue: I was very glad to find the proposal so well received by the Council, and the work has been worthily inaugurated by Major Tennant's paper. Since 1860 we certainly do know a little more about solar eclipses, as it was then my good fortune to make some successful observations. I remember I was very anxious to get information as to the probable intensity of light in the red flames, but could obtain no certainty on the subject. I therefore allowed one minute for each photograph, but afterwards found, by the accidental shaking of the telescope leaving successive impressions, that twenty seconds were enough;

and I therefore feel sure that in the focus of my reflector instantaneous pictures could be taken. I cannot hope to go to India myself, but I should be happy to lend a spare 13-inch mirror, with tube and apparatus, for the experiments. I bestowed great labour on taking photographs of all the phases of the eclipse, and worked out diameters of the sun and moon afterwards, but I do not recommend that this should be done again. From the pictures of the red prominences, it is clear no change in their form takes place during the totality. It was also seen that some part of the corona, at least, belonged to the sun. What we want to know is the physical constitution of the red flames. Then comes the idea that the spectroscope will help us, and then we naturally think of Mr. Huggins. If he could be induced to go out, we should feel sure that all that was possible would be done, for it would be as useless to set untrained observers to use the instrument as to expect a man who had never handled a tool to work a lathe by Holtzapffel. Something, also, should be done with the Polariscope as to the light of the corona. The question of diameters may be safely left to ordinary measurement, but photographs should be taken to identify the red flames, which the spectroscope may analyse. As to expense, I think it will be, probably, more than 2,000*l.* or 3,000*l.*, and I hope application will be made for a sufficient sum, as there is much to be done in the way of preparation both here and on the other side. My expedition cost 500*l.*, even with all the assistance given us by Mr. Vignolles; and all who went know how efficient that assistance was; in fact it is not too much to say that without his co-operation no heavy baggage could have been got inland from Bilbao at all.

Mr. Vignolles: I think it is time to have done with Mr. Vignolles, and look to the interests of science. Major Tennant says observers will not be subject to uncertainty of climate; but the very alteration of temperature produced by the eclipse may cause condensation and clouds.

The President: The alteration in Spain was wonderful. The peasants were glad to put on their sheepskin cloaks, and those who had none to crouch down in the heather.

Mr. Vignolles: This shows the necessity of duplication, or even triplication, of the observers, and that we must not confine ourselves to one place. In Spain, out of fifty parties very few got a successful observation. There is the chance of the monsoon not being over, and the possible condensation I have referred to.

The President: In Spain half the observers landed at Bilbao, and the rest at Santander. I am afraid not one of the latter saw anything.

Mr. J. Beck: I am very glad to hear this eclipse is likely to be observed. The spectroscope will be a most valuable instrument for the purpose, and if I could at all have been spared from business I should have liked more than anything to have seen the corona in a polariscope. Before going to Spain in 1860, I tried to obtain information as to the probable effects, but could get little, and therefore had to adjust my instruments and test them as best I could before going. During the totality I was amazed at the great amount of polarised light, and thought, but probably erroneously, that it came from the corona. It may have been caused by the multiple reflections in our own atmosphere. If I can be useful in lending my instruments, or improving them as may be suggested, I will gladly place them at the disposal of any scientific expedition.

Sir E. Belcher: As an observer at many places on the equator, I may say I never found any difficulty from climate up to elevations of 2,000 or 3,000 feet.

On the Planet Mars: with a Series of Drawings made during the late Opposition: by Mr. Joynson.

From these drawings it appears there is no doubt that one band, near the S. Pole, is permanent. Its colour is green.

On the Spectrum of Mars: with some Remarks on the Colour of that Planet: by Mr. Huggins.

During the late opposition of Mars, the author made observations of the spectrum with the instrument he generally uses, sometimes furnished with one prism, sometimes with two. It was stated in a former paper, that once several strong lines of absorption were seen in the more refrangible part of the spectrum of Mars, and on the recent occasion groups of lines were again seen in the blue and indigo; but the faintness of this part of the spectrum did not permit of their measurement, and consequent determination, whether they were solar lines or others due to reflection from the planet itself. Several strong lines were again seen in the red. Fraunhofer's C was identified, and there are others, as far as the red end can be traced—one between C and B is about a fourth of the distance from the former to the latter. This appears to be a line not found in the solar spectrum, and therefore due to the planet's atmosphere. On February 14th faint lines were seen on both sides of Fraunhofer's D. These were similar to the lines seen when solar light traverses the lower strata of our atmosphere; but as an examination of the light from the Moon, then at a lesser altitude than Mars, showed that neither Mars nor the Moon were low enough to have the lines thus produced, it is pretty clear that they are the result of absorption by the planet's atmosphere, and it was suspected that they were most distinct in the light from the margin of the planet's disc. The spectra of the darker portions of the disc appeared dusky in comparison with the lighter parts of the surface, indicating that the light is absorbed equally, and the colour of those parts neutral or nearly so. Mr. Huggins thinks the ruddy colour of Mars is not due to its atmosphere, but to the materials of which the body of the planet is composed; and he remarks, in support of this opinion, that the polar regions are free from colour, though the light from them traverses a greater depth of atmosphere than that from the central parts. He also refers for corroboration to the photometric researches of Seidel and Zöllner, which show that Mars resembles the moon in the anomalous amount of variation of the light as it increases and decreases in phase, and in the greater brilliancy of the marginal portions of the disc. Zöllner has also shown that the albedo or mean reflective power of the different parts of the disc is not more than about one-half greater than that of the lunar surface, showing that the light of Mars is reflected almost entirely from the true surface of the planet, and not as in Jupiter and Saturn from their envelope of clouds, and in which the light diminishes at the edges, the mean brightness being respectively 4 and 3 times that of the moon. Zöllner also supposes that the anomalous degradation of the moon's light before and after the full may be accounted for by inequalities on its surface, and a partly regular reflective property of its rocks. The mean angle of elevation of these inequalities will be 52°; and on the same view, the more rapid changes of Mars would require an angle of 76°. Both Sir J. Herschel and Professor Bond agree that the reflective power of the moon is equal to the 'grey, weathered surface of sandstone rock;' and Zöllner confirms this. He says the albedo of the

Moon	= 0·1736	of the incident light.
Mars	= 0·2672	„
Jupiter	= 0·6238	„
Saturn	= 0·4981	„
White paper	= 0·700	„
White sandstone	= 0·237	„

From this table, Mars absorbs 0·7328 of the light it receives; but Jupiter's cloudy surface, like white paper, rejects 6 tenths of that which falls upon it. The photographic operations of Mr. De la Rue and others have shown that the chemical rays are similarly affected; but we know nothing of the reflective power of the planets for the slower vibrations which we call heat.

The President: The analogy between the atmosphere of Mars and the Earth is very satisfactory, as the planets have so many conditions in common. It also agrees with the speculations of other men; but Mr. Huggins has reason for his opinions. The science is still in its infancy, and we struggle and grasp at everything likely to help us; and doubtless posterity will benefit largely by these efforts at obtaining knowledge.

Mr. De la Rue: With regard to the degradation of the moon's light near the terminator, and which Mr. Huggins is inclined to attribute to the light falling at a certain angle, I would remark that points near the terminator, of equal brightness with those at a distance, are photographed with infinitely greater difficulty than the others; and I therefore cannot resist the idea that some vapour is condensing and distilling over, as it were, at this boundary of light and darkness.

Mr. Huggins: The point I made is, that the Moon and Mars reflect more light than they ought, and that the moon's light, directly after the full, degrades much more rapidly than it increased.

Mr. Browning: I should like to know if anything in the spectra of the neutral parts of Mars indicate that they are water?

Mr. Huggins: No. I called attention to them to introduce the observations of Zöllner.

Extracts from the Log of the Ship "Evangeline," Captain Wood: communicated by Captain Toynbee.

These were observations of the luminous meteors of November, and included a notice that they were also numerous on October 28th.

On the Determination of the Distance of the Sun from the Earth, by the Parallactic Inequality in the Moon's Motion: by Mr. Stone.

As the mean solar equatorial parallax deduced from the observations of Mars in 1862 was 8″·94, and that deduced by Hansen was 8″·92, whilst Delaunay had adopted 8″·75, it appeared to the author that a fresh determination of this quantity ought to be made from lunar theory. He had, therefore, discussed all the Greenwich Altazimuth Observations from 1848 to 1866, and the Transit Circle Observations from 1853 to 1865. The observations from 1848 to 1861 were compared with Burckhardt's Tables. When these were used, the mean results were always grouped into periods of nine years, so as to obtain a complete revolution of the apse, and a semi-revolution of node. The observations from 1862 to 1866 were directly compared with Hansen's Tables.

The Altazimuth Observations from 1848 to 1861 produce 8″·86 as the result. The Transit Circle Observations alone from 1853 to 1861 come out rather smaller, 8″·79—the Altazimuth alone from 1862 to 1866=8″·83, and the Transit circle from 1862 to 1865=8″·76—the mean being 8″·84. The observations used were 2075 in number, all made near the point of maximum effect of the parallactic inequality, and the result may therefore be looked upon with confidence. Still there are points of difficulty. The observations at 6 P.M. are made on one limb of the Moon, and at 6 A.M. on the other. This, therefore, renders the result subject to any error in the adopted value of the diameter of the Moon. Another thing is that we get a great change of temperature between the two observations, and if there be any error in the refraction tables it will be carried into the result. Mr. Stone used Delaunay's theory, which carries the approximation to the seventh order, but the last term is still equal to 0″·38, which might perhaps leave an error in the co-efficient of this inequality of nearly four-tenths of a second. The result given above with a probable error of 0″·06 is, however, probably very near the truth.

The President: It is impossible to avoid being impressed with the extreme accuracy of the Greenwich observations, and the extreme accuracy at which astronomers are aiming, and the great labour they take to obtain it.

On the November Meteors: by Mr. Kincaid.

The meteoric shower of the 13th was observed from 12 to 4 A.M. of the 14th. They were extremely numerous, and the author's attention was particularly directed to the discovery of a second radiant point which he found near the principal one, but the difficulty of tracing the meteors back when the origin was so close was very great. This second centre is almost identical with μ Leonis, about 3° or 3½° N. of the grand centre. There was a marked tendency in the meteors to converge to γ Pegasi, which was not directly opposite. Three principal paths were noted. Other points referred to were the frequency of ruddy meteors with blue trains, the absence of explosive sounds, the occasional interruption of the trains, and the fact that no meteors were seen between the clouds and the earth.

Mr. Browning called attention to the recent solar eclipse of March 6th, and exhibited a diagram showing that the maximum decrease of temperature did not occur till half an hour after the middle of the eclipse, probably due, in accordance with Prof. Tyndall's observations, to the vapours in the lower atmosphere stopping the loss of heat. The change was small, the thermometer falling from 39°·5 to 39°, and then rising to 41°.

Mr. Huggins: There is a short paper by Mr. Lassell, on the Eclipse, and he states the change of temperature was hardly felt; certainly not half a degree.

Mr. Burr: Where did he observe?

Mr. Huggins: At Maidenhead.

Mr. Browning: For this occasion I used a plane glass, very thinly silvered, as recommended by Foucault, for object glasses, placed over the mouth of the telescope. This answered very well, and when tried before the eclipse, I saw very small spots beautifully defined. The Sun appears of a bluish neutral tint.

Half an hour after the eclipse began I saw the mountains on the Moon's edge very distinctly.

Mr. Stone: It must have been only the boiling.

Mr. Browning: No; the prominences were permanent, though they undulated in height from boiling.

Mr. Stone: I happened to be watching the Moon's limb very carefully for a particular purpose, and saw no elevations.

Captain Noble: I saw one at least, very plainly.

Mr. Browning: Just before the end of the eclipse the clouds appeared granular, and upon throwing the telescope out of focus and adjusting on the clouds, I found a tremendous snow-storm was going on in the upper air, and the velocity being magnified, the snow looked like enormous iron hail. Very few flakes of this storm reached the earth.

Mr Huggins: At Maidenhead, Mr. Lassell lost the last contact through the obscuration of a snow-storm, so that it fell there.

Mr. Stone: I was observing the motion of the Moon across the Sun, at Greenwich, and taking micrometrical measures. I feel certain that unless Mr. Browning's drawing be very much exaggerated, I couldn't have taken the transits I did with such prominences.

Mr. Browning: The elevations are drawn on a very different scale to that of the disc of the Sun.

Mr. Stone: If the vertical and horizontal scales are not the same, it offers a perfect explanation of the matter; for I feel sure I could not possibly have measured the limb as I did if it were like the drawing.

On the Solar Eclipse, March 6: by Capt. Noble.

The first contact was lost through clouds, but at 20h. 16m. 58s. L.M.T. the Moon had made a decided indentation on the Sun's limb. The lunar irregularities were distinct, and one high mountain very conspicuous. About 22h. 15m. L.M.T. the Moon's limb could be traced one or two minutes beyond the place where it crossed the cusps of the Sun, the contrast between its jet blackness and the blue of the sky being very marked. About the same time, Capt. Noble believes that he saw a good deal more of the southern limb of the Moon, visible beyond the Sun for 8 or 10 minutes of arc, projected on the very ghost of a halo.

The President: Were you using a coloured glass?

Capt. Noble: Yes, a dark-blue one.

The President: That will account for anything.

Capt. Noble: The last contact was very well observed at 22h. 51m. 50s. L.M.T. The light of the Sun was strangely affected at the time of greatest obscuration, being like the appearance before a thunderstorm; so much so, that it attracted the attention of the country people.

The meeting then adjourned.

Some Remarks on Comets (Ast. Nach. 1631). By Professor Bruhns, of Leipzic. Translated by W. T. Lynn, B.A., F.R.A.S., of the Royal Observatory, Greenwich.

The notice given in *Ast. Nach.* 1626, concerning Le Verrier's orbit of the meteoric shower of 13-14 November 1866, induced me to investigate whether Biela's Comet, which separated at the end of 1845 into two portions, might possibly at the time of its division have been in the orbit of the meteors. The following numbers do actually afford a great probability of this. If we calculate from Santini's ephemeris (*Ast. Nach.* 557) the heliocentric longitudes, latitudes, and radii vectores of the comet, and for these longitudes the latitudes and radii vectores of the orbit of the meteoric shower, we thus obtain—

	Heliocentric Longitude	Heliocentric Latitude of Comet	Log. rad. vector	Hel. Lat. of the orbit of the meteoric shower at the same Longitude	Log. rad. vector. of the orbit of the meteoric shower at the same Longitude
1846, Jan. 0	59° 21′	3° 29′	0·0356	2° 4′	9·9974
„ 4	63° 18′	2° 35′	0·0208	3° 8′	0·0000
„ 8	66° 59′	1° 35′	0·0064	4° 3′	0·0034

So that on January 2—8 the comet had, with a point in the orbit of the meteoric shower, not only the same longitude, but also the same latitude, and the distance between the comet and that point of the orbit was only 0·05. One need only alter the orbit a little, to make the comet, on the first day—1845, Dec. 29—on which it was seen to separate, pass through the orbit, or if one conceives, instead of the orbit, a whole ring of meteors, in which the shower returning at intervals of 33¼ years needs only to be an accumulation at one point, we can easily suppose the diameter of the ring to be so great that the comet was in that ring on the 29th of December. As a passage of the comet through the meteoric orbit takes place some 40 days before the perihelion passage, both the separation in 1845, and also further divisions in the years 1859 and 1866, or a change in the orbit of the comet, may possibly be thus explained.

In the years 1865 and 1866 we have had remarkably few comets. I do not know whether those astronomers who search for comets have searched less than usual in those years; but I should be inclined to doubt this, and have on my part sought with especial diligence. Now, since I also, in the year 1856, when there was no comet, sought very diligently, this deficiency of comets surprises me. If we consult more closely the catalogue of comets, we find that, omitting of course the periodical ones, a gap occurs in the cometary appearances of the years 1843 and 1844, at which time they were much sought for. Assuming that since 1842 they have been regularly sought for, we find that (not reckoning the periodical comets whose return can be predicted beforehand) between the perihelion times of Comet II. 1843 and Comet II. 1844, an interval of more than 17 months; between the perihelion times of Comet IV. 1855, and Comet I. 1857, an interval of 16 months; and lastly, between the perihelion times of Comet I. 1865, and Comet I. 1867 (Comet I. 1866 is omitted as periodical), an interval of 24 months. In this whole space of 24 years, there occurs, besides, between two perihelion times of comets, only once an interval of so much as 13½ months, viz., between Comet III. 1849 and Comet I. 1850. It is most remarkable that the greatest gaps coincide with the times of minima of the solar spots: also at the time of the earlier solar spot minima 1800, 1810-11, 1822-23, 1834-35, there occur such intervals of tolerable length, but in those times long gaps also occur between other cometary perihelion times, which may undoubtedly be ascribed to less diligent searches after those bodies.

Whether a connection (to me not probable) between the solar-spot minima and the minimum of the cometary appearances really has place, or whether the period of this minimum has only nearly the same duration, needs not yet be discussed, since the fact of the period is not yet certain. My intention does not now go beyond calling attention to these minima of cometary appearances, and perhaps to hear whether, by other persons, they have been diligently sought after.

In a planetarium constructed a short time since, in which only the orbits of the principal planets and the periodical comets are included, I have been struck by the great similarity of orbit between the periodic comets and the planets. The great nearness of orbit of Encke's Comet with Mercury, of Biela's Comet with the earth, of Brorsen and Faye's Comet with Jupiter, is already known, and I will bring forward some calculations concerning the other comets. Can it be that all the periodical comets have obtained their orbits from the influence of planets or of the ring of meteors?

The orbit of De Vico's Comet approaches at the longitude 287°·5 the orbit of Mars, within the distance 0·011, and the comet was at that distance from Mars' orbit on the 29th of June 1844. Mars was then far distant from that point in his orbit, but, by calculating backwards and forwards, we find that, on the 1st of April 1817, Mars and De Vico's Comet, with its period of nearly 2,000 days, may have been within that distance of each other. Also, on the 18th of October 1871, Mars will be in that point of his orbit, and the comet, with period of 1,994·4 days, would again be quite in his neighbourhood. The periods 1,994 and 2,000 days are quite within the limits which Director Brünnow has found for this comet. The orbit of the comet approaches that of Jupiter near the aphelion within the distance 0·42, and Jupiter may have been very near the comet in the year 1814, about the end of May; moreover, six periods of Jupiter are nearly equal to 13 of the comet.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

PERFORMANCE OF OBJECT GLASSES.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Will you permit me to inform the readers of the *Astronomical Register*, that in the engraving of my diagram of γ *Androm.* in the number for this month, the disks of the close pair forming γ^2 *Androm. are much too small?* Their centres are nearly at the proper distance, but the clear black division between the components ought not to be greater than about one-fifth of the diameter of the larger (*B*); or one-fourth of that of the smaller (*C*). Also that the small companion of δ *Cygni* is too far from δ by about the diameter of the small star.

Your obedient servant,

Hopefield Observatory, Haddenham, Bucks: W. R. DAWES.
1867, March 13.

[Four other letters on this subject are in type, and will appear in our next.—Ed.]

THE NOVEMBER METEORS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—With regard to the question of S. J. C. in your February number, I presume that the rapid attainment of the maximum in the meteor shower last November must have been owing to the rising of the radiant point; for, before it rose, no meteors but stray ones could be visible, except a few towards the east. It appears to me that, other things being equal, the number of meteors visible at different places must vary nearly as the sine of the altitude of the radiant point. If this is the case, though the number of meteors visible to one observer, per 5 minutes, in England, was about 17, 195, 40, 19, 10, 3, at hourly intervais from 12h. to 5h., if the radiant point had been in the zenith these numbers would have been about 66, 488, 73, 28, 13, 4.

T. B., in your January number, mentions that he saw a "luminosity to the south and west" on the morning of November 13. May it not have been an aurora? It was mostly cloudy here, but I noticed a luminosity in some parts of the sky, but could not decide what it was. The probability of its having been an aurora is rendered greater by there having been undoubted auroras on both the preceding and following night.

Yours respectfully,

Sunderland. T. W. B.

REFRACTION ACCORDING TO MR. HICKSON.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Without presuming to enter upon the general subject of Mr. Hickson's speculations on the November shower of meteors, there is one statement he makes of so astounding a character, that I feel compelled to challenge it *in limine.*

It is this :—" . . . . It is probable that the smaller planets of our system are only rendered visible by the refractive powers of the earth's atmosphere, which act upon bodies above or beyond it as a magnifying lens, by collecting and converging the rays of light!" Has Mr. Hickson any work on Optics in his library? because, if so, let me entreat him at once to read up that section of it devoted to refraction; and then say in what conceivable way any medium, *bounded by two parallel surfaces,* like our atmosphere, can either "collect" or "converge" rays of light. And if, after the perusal of any elementary work on the subject upon which he incidentally treats, he still thinks fit to propound a dogma to which no living authority could or would subscribe, then perhaps he may learn from Piazzi Smyth's "Teneriffe" (as a matter of fact, and not in the least of theory) that the higher we ascend above the earth, or, in plain words, the more we get rid of the atmosphere altogether, the infinitely better do we observe small stars—a 4-in. telescope at the altitude of the Peak of Teneriffe rendering stars easily visible, which 5 and 6-in. glasses are almost powerless to show at the level of the sea; and stars being palpable to the naked eye, which at a lower level cannot be discerned without an opera glass.

I am, Sir, obediently yours,

March 4, 1867. N.

THE NAUTICAL ALMANAC.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Pray permit me to thank Mr. Alfred Deey for his reply to my questions. Will he kindly follow it up by explaining a further difficulty?

I. I understand him to say, that if I would take a transit of Saturn at this place (9m. 49·67s. W. long.), I must get the declination from the *second* of the two ephemerides, increased by the proportional part of 2·3″ for this longitude; but that for the time of passage I must refer to col. 5 of the *first* ephemeris.

I do not understand why—except it be for "a short and easy method" of discovering my watch error, without the trouble of reducing sidereal to mean time. Why use the first ephemeris at all? In taking transits of the stars we have but one ephemeris; this gives us the R.A. or "apparent places for the upper transit at Greenwich." How does this differ, in its use, from the second, or "ephemeris at transit," of the planets?

II. But I have a further difficulty. I want the "explanation" at p. 537 of the *N. A.* explained; so much so, that I almost fear to state all that puzzles me.

1. In line 7 of what relates to "planetary ephemerides at transit," why "midway?"

2. Line 8. How are "they given at intervals of two transits," when, in one column or the other, we have that of each day?

3. Why, "say, as 48h. is," &c.? This is stated to be the variation in *one* hour.

4. And generally, I cannot discern the *rationale* of the process directed. I should have thought the method was much simpler; *e.g.* (adopting the example of Mercury there given), if left to myself, I should have done as follows:—

As 1h. of long. is to the Var. in 1h. of long., so is the longitude of the place to the correction required.

1h. : 13·62s. :: 4h. : 64·48s.

∴ 9h. 1m. 20·87s. *minus* 64·48s. = 9h. 0m. 16·39s.;

a result which would make the clock appear slow by 10·32s. So the only result at which I can arrive with certainty is, that I am in a confusion, out of which I shall be truly thankful to be helped.

Feb. 16, 1867. ATHLETA.

OUTLINE OF THE MOON.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Allow me to ask a question of some of your scientific correspondents with respect to the outline of the Moon. I don't clearly understand why the Moon's edge which is nearest the Sun, I mean (optically), is always a *smooth* portion of a *well-defined* circle. We must remember that the Moon is a *globe*, possessing a very mountainous surface: at least that part of the surface which is turned towards the earth. Now, we always see a *broken* and unequal outline on the side farthest from the Sun; indeed, the summit of a mountain *detached* from the illuminated part is sometimes seen when the Moon is two or three days old, and the whole of the said side of the crescent is *irregular*. Now, as we know that the mountainous ranges do not abruptly stop where the illuminated edge begins, I wish to know why there is not an outline on the "side that is next the Sun," similar to the other?

In the late eclipse of the Sun, March 6th, some observers have stated that they saw the circular edge *serrated* or jagged (of course by the medium of a telescope), and this would naturally be the result of an observation carefully carried out with a good instrument.

Any information upon this subject will oblige your old correspondent,

March 20, 1867. READINGENSIS.

THE LUNAR COMMITTEE OF THE BRITISH ASSOCIATION has issued a circular announcing the epochs at which it would be most desirable to obtain photographic pictures of the Moon, and measures for points of the first order during the remainder of the year 1867. The circular contains four tables of the epochs of the visibility of those regions about the North and South poles, and the East and West limbs, that are concealed when the disk is in a state of mean libration. There are five days which are favourable for viewing the regions about the North pole, four for the regions beyond 90° of West longitude, nine on which the South polar regions are favourably situated, and six when the regions beyond 90° East longitude may be well seen. In each case the proportion of the illumination of the disk is given, and the position of the terminator—or boundary between light and darkness—indicated by the degree of longitude East or West on the Moon's equator, which it cuts, and by the angle which it forms with the meridian on the Moon's surface, which it intersects. The longitude of the terminator for any of the days given may readily be found on Beer and Mädler's or Lohrmann's maps, the angle at the same time showing its course among the objects, so that pictures of selected features, and measures for points of the first order, may be obtained under extreme states of libration in latitude, when the Moon is passing Perigee or Apogee; or extreme states of libration in longitude, when the Moon is passing either node, especially during the spring months. The Moon will not be in a state of mean libration during the present year.

THE ECLIPSE OF THE SUN, MARCH 6th, 1867.

The morning of the 6th was bright, but it became overcast just before the commencement of the eclipse, and owing to this cause the first contact was not distinctly seen. As the obscuration progressed, the dark body of the Moon was beautifully discerned during the intervals of passing clouds and mist, which occasionally permitted the Sun to be viewed without a dark glass. Shortly before 10 o'clock the sky became quite overcast, after which a slight shower of snow fell, and nothing more was observed until half-past 10, when an occasional break in the clouds occurred. Fortunately, however, it became comparatively bright just before the termination, and the last contact was seen fairly. For a few minutes previous to the end of the eclipse, snow was observed in the telescope drifting rapidly across the Sun's disc, although none fell to the ground, and, as before, the clouds were thick enough at times to render a dark glass unnecessary, but as the Moon passed off the Sun's limb a light shade was required. It was distinctly noticed, by those who were observing the phenomenon, that more of the Moon's disc could at times be seen than the portion which was projected on the Sun. The cloudy state of the atmosphere prevented any observation being made as to any decrease of light owing to the eclipse. No spots were observed on the Sun's disc. The telescope used was by Dallmeyer, equatorially mounted by Cooke & Sons: a Hodgson eye-piece with a power of 45 was employed.

Downs Road, Clapton: March 1867.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Though it is rather late to be sending you my account of the late solar eclipse on the 6th inst., yet, if space remains in the pages of your increasingly valued *Register*, the following remarks may prove not uninteresting to your readers.

The morning of the eclipse in this part of the kingdom was far from promising, the sky being much obscured by abundance of light drifting clouds, in consequence of which neither the first nor last moment of contact was visible from this station.

At intervals, however, very good glimpses of the phenomenon were obtained, either through briefly clear spaces between the clouds, or through the thinner veils of the nebulous vapours and snow drift.

At 9h. 32m. A.M., which must have been about the period of greatest obscuration, the breadth of the bright solar crescent measured about 8′ 28″ (the total diameter of the Sun at this epoch being, according to the *Nautical Almanac*, 32′ 18″), the distance between the cusps at this minute being 29′ 52″: whilst at 9h. 35m. the eclipse had evidently begun to diminish; the breadth of the solar crescent having now increased to 9′ 10″, whilst the distance between the cusps was also increased to 30′ 20″.

At intervals, exceedingly clear and steady views of the phenomenon were enjoyed either by direct vision (and without the intervention of any darkening glass), when the Sun was only slightly screened by vapour; or, again, by projection on a screen (placed a yard or so from the eye-piece of the telescope), during the moments when his rays were bursting more freely from between rents in the clouds; and on both such occasions (and specially perhaps the first) I noticed, at the moments of best definition, how the solar cusps appeared as sharp as a needle—an argument this, of course (as others have also observed), in favour of the non-existence of any appreciable atmosphere around those portions, at least, of the Moon. The telescope employed on the occasion was my veteran little instrument by the elder Dollond of 3-in. ap., power 120, and of rare excellence for its size.

The only spot on the Sun's disc that morning was a minute one of not more than 8″ in its greatest length—and which at 9h. 50m. was 4′ 30″ from the nearest part of the now retreating limb of the Moon.

The phenomenon of the aërial snow-shower mentioned by Mr. Browning in a recent impression of the *Times* has not unfrequently been noticed by me (especially at this season of the year) during the many hundreds of occasions when I have been scrutinising the Sun's disc by means of its projection on a screen. I remain, Sir, yours faithfully,

St. Augustine's Parsonage, Hurst Green, FRED. HOWLETT.
Sussex: March 16, 1867.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I do not know if the following remarkable, though perhaps in some measure fortuitous, coincidence is worth recording in the *Register*.

The last contact of the ☽ with the solar disc was observed by me on the 6th with Ross's 3⅜ equatorial (formerly in the possession of Mr. Burr) at 21h. 40m. 37s. sidereal time; which was found equivalent to 22h. 54m. 10·2 G.M.T.

On calculating, yesterday, the time from the formulæ given in the *Nautical Almanac* for places not far from Edinburgh, I found the result to be 22h. 54m. 9·7s.

I did not catch the first contact, owing to the clouds. The sky was remarkably clear during more than the latter half of the eclipse. I did not perceive a single spot on the Sun's disc. The edge of the Moon was seen well *notched* on the luminous disc.
Yours truly,
University of Aberdeen: DAVID THOMSON.
March 9, 1867.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—It may interest some of your readers to know that the eclipse was well seen here. I got an excellent view of it, a few minutes after its commencement, with my 3 foot achromatic, 2-inch aperture, power 65. The Sun's disc was very well seen, but no spots were visible, and the margin of the small segment of the Moon projected on the Sun was quite smooth, with the exception of one conspicuous projection, which immediately caught my eye, about the middle of the segment. The cusps were quite sharp, and the progress of the eclipse well seen till about 9 A.M., at which time a large portion of the Moon was projected on the Sun's disc; but no other projection was noticed except the one just mentioned, which was well seen and very conspicuous. After 9 o'clock the sky became covered with clouds, which, although they prevented anything being seen in the telescope, were of just sufficient density to allow the phenomena to be beautifully seen by general gazers; and the difference in diameter of the Sun and Moon was beautifully seen and generally noticed.
Yours very truly,
Blucher Street, Chesham, Bucks: CHARLES GROVER.
March 9, 1867.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I had a fair view of the eclipse this morning, but clouds, which prevailed more or less the whole time, prevented my observing either the beginning or the end. I was in hopes to have noted the termination, and a small projection I had made gave me 10h. 45½m. G.M.T. for the time. Just as it was approaching, thick clouds passed over, and when the Sun appeared again at 10h. 45m. 59s., the eclipse had ended.

I observed nothing at all remarkable; no blunting of the cusps, no irregularities on the Moon's limb; diminution of light hardly if at all perceptible. Owing to clouds, there was no need most of the time to use a coloured glass. I used 3¾-in. aperture and 60 power. G. J. WALKER.

[The following note accompanied a stereoscope slide, containing four views of the eclipse, in which the phenomenon is very sharply defined.—ED.]

The photographs which I have the pleasure to enclose, are intended to show the use of the apparatus I now employ in this kind of work. The plate marked No. 3 contains four photographs taken at the time of greatest obscuration, and the time occupied in taking the four negatives was only 30 seconds; and the plate No. 5 was obtained in 20 seconds: the exposure in each case being as instantaneous as could be made, by hand, with the aperture of the telescope reduced to half an inch. The advantage of taking four or more negatives on the same plate is so obvious that it is unnecessary for me to say more on the subject.

By combining the prints or plates 3 and 4 in the stereoscope, the effect of relief is obtained. The difference in time was about 7 minutes.

A. BROTHERS.

Descriptive Astronomy. By G. F. Chambers, F.R.A.S. Oxford, at the Clarendon Press; London, Macmillan.

Mr. Chambers's long-announced work on Astronomy is now before us; and as popular works on the science are not very numerous, we have no doubt it will be welcomed by a large circle of readers. It was looked for as a second edition of the "Handbook of Astronomy," but the many additions and improvements contained in the present book render it almost entirely a new work. It is scarcely possible for writers on any of the sciences in the present day to keep pace with the rapid advances now made; if an author dwell over his work so as to present it to the public in a perfect form, as far as may be, he will find that the science he is treating of has left him behind, and that numerous discoveries remain unnoticed. Under such circumstances, Mr. Chambers is entitled to credit for the recentness of the information he has presented to us. In a very readable book he has collected together, from all sources, almost everything that is known at the present time in connection with the science—a full description of the Sun and Planets; the Phenomena of Eclipses, Transits, &c.; a very complete account of Comets—a subject Mr. Chambers has made peculiarly his own; Chronological Astronomy; Stars, Star Clusters and Nebulæ; and a mass of information as to maps, charts, catalogues, instruments, &c., relating to the subject in hand. Such are the contents, very profusely illustrated with woodcuts, of a very attractive addition to our astronomical literature.

THE PLANET MARS.

We have to acknowledge the receipt of nineteen very carefully drawn views of Mars, by Mr. T. G. E. Elger, of Bedford, with a telescope by Cooke, of 4 inches aperture, power used 250 and 300. The drawings were accompanied by a description of the appearance of the planet at the several dates upon which they were taken, with the attending circumstances, &c. Mr. Elger adds, "The colour of the planet's disc appeared to me to be invariably reddish or orange in the centre, and light yellow round the border. The markings could never be traced quite up to the limb, but always seemed to terminate before reaching it."

The features in these drawings are very similar in appearance to those given by Mr. Green and Mr. Banks in the *Register* for March 1865.

We have also a set of careful pencil drawings, by Mr. Grover, of Chesham, Bucks, taken by means of a 2-inch telescope, which give the general markings of the planet very well, and show what can be done even with a small instrument. The Rev. D. T. Knight, of Earls Barton, also sends some sketches made with a 5-inch object glass, in which the general features are to be found. In order, however, to give the details of the planet's surface in such a manner as to enable its "coast lines" to be recognised with facility, much greater optical power is required than what is noted above. The drawings by Mr. Dawes in the September number of the *Register* for 1865 were made with an 8-inch object glass, and it requires even more powerful means, and every atmospheric facility, before we can hope to obtain that accuracy of delineation of the planet's surface which is so much to be desired. It is greatly to be regretted that the possessors of the many powerful instruments of eight, nine, or ten inches in diameter, now in existence, are not able or not willing to employ them in this most interesting field of practical astronomy—planetary delineation.

ASTRONOMICAL OCCURRENCES FOR APRIL 1867.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Mars. —
Mon	1	 1 7	Sidereal Time at Mean Noon, 0 37 30·5 Conjunction of Moon and Venus, 2° 27′ S.			6 49·2
Tues	2		Meridian passage of the Sun, 3m. 44s. after Mean Noon	1st Ec. D.	17 10 15	6 46 8
Wed	3	7 19	Conjunction of Moon and Mercury, 1° 55′ N.	1st Sh. E. 3rd Ec. R. " Oc. D.	16 48 17 7 57 17 26	6 44 4
Thur	4	10 4	● New Moon			6 42·1
Fri	5					6 39·8
Sat	6		Declination of Mars + 24° 6½′			6 37·5
Sun	7					6 35·2
Mon	8	2 9 3 9	Occultation of *Aldebaran* (1) Reappearance of ditto			6 33·0
Tues	9	7 33 8 29 23 30	Occultation of 130 Tauri (6) Reappearance of ditto Conjunction of Moon and Uranus, 5° 26′ N.	4th Tr. I.	16 32	Moon. — 4 22·8
Wed	10			1st Sh. I.	16 22	5 21·3
Thur	11	3 9 9 35 12 36 20 0	☽ Moon's First Quarter Conjunction of Moon and Mars, 6° 53′ N. Near approach of Moon to I Cancri (6) Conjunction of Venus and λ Aquarii, 4m.·4 W.	1st Oc. R.	16 55	6 18 6
Fri	12					7 13·9
Sat	13					8 6·7
Sun	14	8 57	Near approach of Moon to 48 Leonis (6)	3rd Tr. E.	15 52	8 57·2
Mon	15	15 55 18 39	Conjunction of Venus and φ Aquarii, 0m.·6 E. Conjunction of Venus and φ Aquarii, 0° 3′ S.	2nd Oc. R.	15 48	9 45·8

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Tues	16		Sidereal Time at Mean Noon, 1 36 38·8			Moon. — 10 33·0
Wed	17		Meridian passage of the Sun, 0m. 23s. before Mean Noon			11 19·4
Thur	18	11 6	○ Full Moon	**1st** Ec. D.	15 26 18	12 5·4
Fri	19			**1st** Tr. E.	16 14	Mars — 6 9·2
Sat	20	8 35 16 12	Conjunction of Moon and Saturn, 2° 4′ S. Near approach of Moon to η Libræ (6)			6 7·1
Sun	21			**3rd** Sh. E. „ Tr. I.	15 25 16 29	6 5·0
Mon	22					6 3·0
Tues	23	7 6	Greatest westerly elongation of Mercury, 27° 6′			6 0·9
Wed	24					5 58·9
Thur	25					5 56·9
Fri	26	14 1	☾ Moon's Last Quarter	**1st** Tr. I.	15 52	5 54·8
Sat	27			**1st** Oc. R.	15 20	5 52·8
Sun	28	18 23	Conjunction of Moon and Jupiter, 2° 42′ S.	**3rd** Sh. I.	15 43	5 50·8
Mon	29	6 45	Conjunction of Jupiter and σ Aquarii, 4m.·2 E.	**2nd** Ec. D.	15 51 10	5 48·8
Tues	30					5 46·9
MAY Wed	1	1 15 2 20 22 53 23 46	Occultation of VENUS Reappearance of ditto Occultation of MERCURY Reappearance of ditto	**2nd** Tr. E.	15 27	5 44·9

THE PLANETS FOR APRIL.

Mercury may be seen for a short time before sunrise during the month. The planet is on the Equator on the 6th, and at its greatest westerly elongation on the 23rd.

		h.	m.	s.			°	′		
1st	R.A.	0	1	56	Decl.	+	2	13½	Diameter	11″·2
15th	„	0	2	2	„	—	1	26½	„	7″·0

Venus passes the Meridian at twenty-four minutes past nine on the morning of the 1st of April, and gradually later until thirty-eight minutes past that hour on the 30th. She may be seen for about an hour before sunrise during the month.

1st	R.A.	22	1	48	Decl.	—	12	12½	Diameter	16″·8
15th	„	23	4	2	„		7	2	„	15″·4

Illuminated portion of the disc of Venus, 0·719.

Mars is still well situated for observation; passing the Meridian about a quarter to seven in the evening, and setting about three o'clock in the morning at the beginning of the month.

1st	R.A.	7	27	21	Decl.	+	24	31½	Diameter	9″·4
15th	„	7	50	54	„		23	18½	„	8″·4

Illuminated portion of the disc of Mars, 0·899.

Jupiter may be seen from an hour to an hour and a half before sunrise during April. The planet's declination is now gradually increasing, so that he may be more favourably observed.

1st	R.A.	21	59	25	Decl.	—	13	5½	Diameter	32″·4
15th	„	22	9	56	„		12	11	„	33″·5

Saturn may now be observed during the night; rising about ten o'clock at the beginning, and about eight o'clock at the end of the month.

1st	R.A.	15	26	41	Decl.	—	16	19	Diameter	16″·6
15th	„	15	23	40	„		16	6	„	16″·7

Dimensions of Ring—Outer Major Axis, 42″; Outer Minor Axis, 16″.

Uranus may be well observed in the evenings, passing the Meridian about a quarter to six, and setting about two o'clock in the morning at the beginning of April.

7th	R.A.	6	20	17	Decl.	+	23	41½	Diameter	4″·0
19th	„	6	21	42	„		23	40½	„	3″·8

Neptune is in conjunction with the Sun this month and consequently invisible.

THE GREAT 25-INCH ACHROMATIC.—A correspondent, who visited Messrs. Cooke's works at York in February last, states that the mounting for this magnificent instrument was then in rapid progress. The declination axis was almost finished—the polar axis was then turning in the lathe—the model of the driving circle, 7 feet diameter, just completed. The object-glass weighs 10 stone, and with the brass cell 14 stone; it is not quite finished yet; the grinding and polishing are effected by machinery under the exclusive superintendence of the principals. We understand that the management of this splendid instrument is to be entrusted to M. Marth, who will accompany it to Egypt, where it is to be erected by the proprietor. If the object-glass turns out to be as successful as it promises, we may expect some very interesting additions to our store of astronomical knowledge from its employment.

INSTRUMENTS, &c. FOR SALE.

These Notices, which are restricted to *two lines* each, are inserted free of charge to subscribers: applications respecting prices and other particulars to be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—For Advertisements with prices and more complete details, a small charge will be made.

N.B.—It is particularly requested that we may be informed when instruments are disposed of, in order that the notice may be withdrawn, and fruitless applications prevented.

Achromatic Refractor, 6·4 in. ap. 8½ ft. focus, by *Merz*, Equatorial and clockwork by *Troughton & Simms.* [73]

Achromatic Refractor, 4 in. ap. 5 ft. focus, by *Dollond;* equatorially mounted. Powers up to 400. [87]

Dialyte Telescope, 4¼ in. ap. 5 ft. focus, price very low. [88]

Gregorian Reflector, 4¾ in. ap. 2 ft. focus, by *Dollond*, 4 powers, 50 to 200, finder, &c., on brass table stand. [63]

Achromatic Object-Glass, 4⅛ in. ap. 62 in. focus, by *Slugg*, with brass cap and receiving cell, for mounting on tube. [85]

Newtonian Reflector, Equatorial motion, metal 7⅞ in., first-class quality; price very low. [100]

Transit Instrument, 3¾ in. ap. 5 ft. focus, Ys fitted with agates for mounting on stone piers. [29]

Two Equatorial Stands, for 5 ft. telescope: with circles, &c. complete. [99]

Equatorial Stand, for a 5 or 6 ft. telescope: 13 in. circles, divided on silver, to 10″ of space and 4s. of time.—Has never been used. [55]

Transit Instrument, ap. 2½ inches, by *Jones*, Charing Cross: with three circles, divided on silver. [98]

Varley Stand, improved, rackwork movements, for a telescope of 5 or 6 ft. focus: on circular turn-table, to point in any direction. [16]

Polar Axis, of mahogany, 7 ft. long, adapted for a 4 ft. telescope, with 12 in. circles, reading to minutes. [56]

Speculum Grinding Apparatus, capable of working a 7 ft. speculum: with tube and fittings for a 9 in. Newtonian. [57]

Electrical Machine, powerful, 18 inch ebonite plate, by *Silver & Co.*, with brass conductor. [93]

Electrical Machine, plate 12 inches in diameter, in case complete. Price low. [90]

Recreative Science: and the first three volumes of the **Photographic Journal:** price very low. [30]

Lardner's Astronomy, latest edition; and **Hind's Illustrated London Astronomy.** Both clean copies. The two, 4*s*. 6*d*. [96]

INSTRUMENTS, &c. WANTED.

Equatorial Telescope, about 6 in. aperture, with driving clock and circles; price moderate. [89]

Astronomical Clock, not very first-class; price low. [65]

Equatorial Stand, for a 5 ft. Refractor: graduated circles. [35]

Transit Instrument, 2 in. ap. 18 or 24 in. focus. [71]

Monthly Notices of the Royal Astronomical Society, Vol. 3. [26]

Monthly Notices: Vols. 3, 4, 5, and 7. [82]

Bartholomew Prescot on the Universe, published 1823: a copy wanted, in good condition. [84]

SPECTRUM ANALYSIS.—With reference to the announcement in our last number of the publication of Mr. Huggins's lecture on the *Prismatic Analysis of the Heavenly Bodies*, it should have been stated that the book is published by Mr. Ladd, with the consent of the author, who is not, however, personally interested in the work.

THE "ADAMS" PRIZE, CAMBRIDGE.—The subject proposed for 1869 is, "On the Determination of the Orbit of a Planet or Comet from Three Observations." This prize, the value of which is £125, is open to all members of the University of Cambridge who have at any time taken a degree. Papers to be sent in before the 16th December 1868.

MR. HOWELL'S TELESCOPE.—If your correspondent F. R. A. S., will refer to page 25 of the 8th volume of the *British Journal of Photography*, he will find, in the paper by Mr. Fry, on Lunar Photography, that the telescope is described as being of 8½ *inches aperture*, 11 *feet focal length*. Mr. Fry would, perhaps, be able to explain the error. I can only give the authority from which I derived my information. A. BROTHERS.

ALCOR.—There must be some mistake in Humboldt's statement that Alcor can be rarely seen by the naked eye in Europe, for I have always found it easily visible, and often looked at it ever since 1859, sometimes when at a high altitude. I have noticed its visibility in moonlight, and have often had it in the telescope without any suspicion of variability. If variable, I think it must have been noticed in so conspicuous an object. C. GROVER.

LIST OF SUBSCRIBERS—Names received since our last number.

Hill, C., Esq., 2 Alma Road, Cotham Grove, Bristol.
Welsford, J., Esq., 18 High Street, Plymouth.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June 1866.
Darby, Rev. W. A.

To March 1867.
Terry, J.

To June 1867.
Broughton, S.
Coulcher, W. M. B.
Freeman, D. A.
Glover, E.
Petty, T.
Welsford, J.

To September 1867.
Birmingham, J.
Brothers, A.
Matthews, W.

To December 1867.
Baxendell, J.
Clermont, Lord.
Hill, C.
Johnson, R. C.
Perigal, H.
Redpath, H. S.
Ryley, F. B.
Stothard, Dr.
Vallack, Rev. B.
Whitbread, S. C.

To March 1869.
Maclear, Sir T.

NOTICES TO CORRESPONDENTS.

Numerous communications, many of which are in type, are unavoidably delayed.

The reprinting of No. 5 will be proceeded with immediately, and the copies will shortly be in the hands of those who desire it.

We give with the present number a very valuable list of Binary Stars by Mr. Brothers, of Manchester, prepared for the Literary and Philosophical Society of that place, by whose permission we are enabled to present it to our readers.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Stamford Villa, Downs Road, Clapton, N.E.*, **not later than the 15th of the month.**

CATALOGUE OF BINARY STARS,

WITH

INTRODUCTORY REMARKS.

BY

ALFRED BROTHERS, F.R.A.S.

PRESENTED TO THE READERS OF THE
ASTRONOMICAL REGISTER,
BY PERMISSION OF THE
MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

XIII. *Catalogue of Binary Stars, with Introductory Remarks.* By Alfred Brothers, F.R.A.S.

Read October 14th, 1866.

From the time of the publication of the first catalogue of double stars by Sir William Herschel in 1782, the search for such objects has been one of unabated interest to both professional and amateur astronomers; and the result has been the compilation of many other valuable catalogues.

The number of double and triple stars discovered by Sir William Herschel and other observers down to the present time amounts to many thousands; but of these, comparatively few have been proved to be binary systems, as distinguished from stars optically double. That such physical connexion might exist was suggested by Michell in 1767; but the honour of establishing the fact was reserved for Sir William Herschel, who appears not only to have ascertained the truth of the supposition beyond doubt, but also to have invented the instrument by which some of his measures were taken*. These early measures of Herschel, and those of Struve, Sir J. Herschel, Argelander, Smyth, Dawes, Secchi and others, form the foundation on which all the subsequent observations are based. They are contained, however, in works not generally accessible to the observer; and I have no doubt that there are many amateurs who, like myself, have felt the inconvenience of having to refer to several sources for information relative to the positions and distances of the binary stars, and who would be glad to possess a more complete list than is usually found in elementary works on astronomy. I have therefore been induced to extend the plan of a catalogue which I had originally prepared for my own use only, and have included the results of the most recent observations of several eminent astronomers, which they have been kind enough to send me for the purpose.

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* Phil. Trans. vol. lxxi. p. 500.

This catalogue is intended to show at one view the measures of the late Admiral Smyth, taken at the Bedford Observatory during the years 1830 to 1842, and from 1843 to 1858 at the observatory of the late Dr. Lee, at Hartwell; also, on the authority of Smyth, some of the measures of the same objects by observers previous to 1830, including Sir William Herschel's epochs from 1778 to 1802, Struve's from 1819 to 1836, and some others. In the columns, following the name of Admiral Smyth, will be found the names of the Rev. W. R. Dawes, the Rev. R. Main, Mr. Knott, the Baron Dembowski, Mädler, the Rev. Father Secchi, Mr. Morton, and Mr. Talmage, with their measures of position and distance. The names of the observers are arranged as nearly as possible in the order of the dates of observation; so that a glance from the first name to the last on the list, under each particular star, shows at once the changes which have taken place during a period of about 90 years, and in some instances of more than a century.

In the cases of stars which are known to have passed their perihelion, the dates are given: these dates are derived from various sources; and it must be remarked that some computors give epochs which do not agree with those inserted. The orbital periods are stated on the authority of Admiral Smyth, and must in almost every instance be taken as approximations only.

The objects are arranged in the order of right ascension, and the places of all those which have been observed by Smyth are reduced to the epoch 1865·0 by using his precessions. There are, however, many objects in the catalogue which were not observed by Smyth. In all these exceptional cases the date (1860) is inserted, and the authority quoted is Secchi. The magnitudes of all the stars taken from the 'Cycle' are those given by Smyth, and in many instances do not agree with the observations of Dembowski and Secchi. In all other cases Secchi's magnitudes have been adopted.

The colours are stated on the authority of Smyth, Webb, Main, and Secchi. It may be observed that the aperture of the telescope used probably influences the observer's estimate of colours, as I find from information received from Mr. Webb that, while using a refractor of 3·7 inches aperture, his colours are often quite different from those recorded as seen with one of 5·5 inches aperture, which was used for all his observations after 1863.

The measures of Dembowski will be found in the 'Astronomische Nachrichten,' Nos. 1473 to 1475, and Nos. 1572 to 1574; and I have given the means of his measures for the years. Those of Mr. Dawes are derived from a list furnished by him; and the same remark applies to those of Mr. Knott. The 'Radcliffe Observations' for 1861–1863 have furnished the particulars of Mr. Main's observations; and to Professor Secchi I am indebted for his list of 1321 double stars measured at the Observatory of the Roman College, and also for a separate list by which the measures of some of the objects are brought down almost to the present date.

The measures of Mr. Morton are derived from Lord Wrottesley's "Catalogue of the Positions and Distances of 398 Double Stars," contained in vol. xxix. of the 'Memoirs of the Royal Astronomical Society of London.' Mr. Romberg's measures are taken from the 'Leyton Astronomical Observations' for 1862–64; those of Professor Kaiser will be found in No. 9 of vol. xxvi. of the 'Monthly Notices;' and the measures by Mr. Talmage were made at Mr. Barclay's Observatory at Leyton, and supplied for the purpose of this catalogue.

As some confusion has arisen in designating the star Flamsteed's "51 Libræ," I have, at the suggestion of the Rev. W. R. Dawes, inserted it as "*ξ Scorpii*" (=*Fl.* 51 *Libræ*), as it undoubtedly belongs to Scorpio, which constellation otherwise has no star marked ξ, while Libra has three stars indicated by that letter. The remarks of Mr. Dawes respecting this star are interesting, and I venture to quote his own words; Mr. Dawes says:—"The interest which attaches to ξ Scorpii $\frac{A+B}{2}$ and C is so exceedingly small compared with that which belongs to A and B as a binary system, that I can only account for the close and rapidly revolving pair being omitted by any of the observers to whose lists you refer by the very probable fact that their telescopes were not competent to show it as a double star. Its low situation, in these latitudes, increases the difficulty of observing it successfully with telescopes which could divide it well." Respecting Dembowski's observations on this triple star, Mr. Dawes also remarks:—"Of $\frac{A+B}{2}$ and C he gives, 1863·14, P=70°·46, D=7·154, and, for 1865, P=71°·02, D=7·112. Whatever weight may attach to these results, they rather go to negative the supposition of C's having any orbital movement in respect of A and B. Indeed, notwithstanding the regular decrease of Struve's angles, I have thought the motion so doubtful as to require observations at long intervals only; and I find I have not measured the star (C) since 1840·56, P=69°·45, D=7·43. Herschel II. obtained P=70°·93, D=7·07 in 1831·38, and at the Cape P=77°·2 in 1834·35. These, compared with Dembowski's more recent results, throw some doubt on former deductions. But no list of binary stars should be without A : B, the variation of angle having amounted to nearly 160° in 40 years, and about 150° since I began to observe it."

Respecting the star 61 Cygni, Powell states (Mem. R. Ast. Soc. vol. xxxii. p. 95), "Surely the movements of the components cannot be of an orbital nature;" and Mr. Dawes also says, in a letter of 8th September 1866, "The motion observed in 61 Cygni is not *orbital*, but *rectilinear*, arising from difference of proper motion." On such authority perhaps the star ought to have been omitted; but it is one of Smyth's binaries, and for that reason, as well as for the special interest attaching to it, it is retained.

The star ζ Herculis was observed to be single from about 1863 to 1865; but the following remarks, contained in the letter from Mr. Dawes above quoted, may be of some interest:—"From the extreme difficulty, or perhaps impossibility, of seeing ζ Herculis in the least elongated in 1863, I imagined it could not be otherwise than 'single' to telescopes of ordinary dimensions in 1865. I find, however, that the small star has made more haste to emerge from its concealment than I supposed to be probable;.... but near the end of October I received a letter from Alvan Clark, informing me that with one of his exquisite object-glasses of 7 inches aperture he had seen ζ Herculis double. He gave me no particulars of angle or distance, and I confess I thought it likely there might be some mistake. On August 31st I turned an 8-inch refractor on to ζ Herculis, and instantly saw the small star perfectly detached from the large one."

μ^1 Herculis.—Of this star I have not found any other measures than those by Mr. Dawes in 1858 and 1864, and by Mr. Knott in 1865; but as the change of the angle of position amounts in 17 years to about 20 degrees, the binary character of the object may, perhaps, be considered established. The measures by Alvan Clark, as published in 1856, are not complete.

π Cephii.—The first measures of this object appear to have been made by Admiral Smyth in 1843; and it is evident from Mr. Knott's measures in 1865 that the star has changed its angle of position 34 degrees, and in distance ·65″ in 22 years, and, consequently, must be added to the list of binaries.

P. III. 98, 145 Leonis, η Orionis, and some others are inserted on the authority of only two observers; but they appear to be binary systems, and deserve attention.

Since the date of the 'Cycle' the number of binary stars has been greatly increased; and several observers have favoured me with the names of stars which have changed their angles of position sufficiently to entitle them to a place amongst that class of objects; and they are accordingly inserted.

To the gentlemen referred to I take this opportunity of returning my best thanks.

With few exceptions, I have not included in this catalogue any object which has shown a change of position of less than 10 degrees in 30 years. There are many stars which may eventually prove to be binary; but their motions are extremely slow, and require examination at long intervals. Of the few stars forming the exception to the rule adopted, I may name Sirius, Antares, and a few others as interesting objects, and deserving close attention on the part of those observers who have telescopes of sufficient aperture to measure the angles of position and distances of such difficult objects.

D. 5 and A. C. 5 refer respectively to the lists of double stars discovered by Mr. Dawes and Alvan Clark.

I do not attach any importance to my own measures; and the following are given merely to show that the work done with a telescope of 5 inches aperture may be useful in this department of astronomy, and that the possessors of such, and even smaller telescopes, may do good work by taking advantage of favourable states of the atmosphere.

The objects selected are those only which are conveniently situated at this season of the year:—

Star.	Epoch.	Position.	Distance.
		°	″
36 Andromedæ	1866·760	349·03	1·29
P. I. 123 Piscium	1866·760	24·40	Wedged.
ε Arietis	1866·769	197·40	Separated.
ε Bootis	1866·725	325·70	2·59
44 "	1866·769	238·60	
δ Herculis	1866·766	180·60	19·34
61 Cygni	1866·701	111·01	18·87
ζ Aquarii	1866·766	337·40	3·58

The first three stars on the above list may be considered good tests for the telescope; but in addition I may say that on several occasions I have seen the companion to δ Cygni; and, still further to test the matter, I requested a friend, who also could see the star, to place the position-line upon it, and a comparison of the angles showed that we had both seen the same object.

With the following information before him, the amateur who has not access to more recent epochs than those contained in Smyth's 'Cycle,' may probably feel greater interest in his work, and more certain of his own measures; for the pleasure of observing and recording observations is greatly enhanced when we feel that our results approach the accuracy of the more practised "astrometer."

Of the 155 objects which this catalogue contains, 69 appear to have direct, and 86 retrograde motion.

It should perhaps be stated that some of the measures for 1866 depend on a small number of observations, and may be subject to correction.

Cephei 316. Σ 2.

R. A. (1860), $0^h\ 1^m\ 30^s$.
Dec. N. 78° 56′.
Magnitudes, $a = 5\frac{1}{4}$, $b = 6$.
Colours: Secchi, 1857, yel., green.

	Epoch.	Position.	Distance.
		°	″
Struve	1830·85	341·50	0·81
Mädler	1838·63	338·14	0·69
Dawes.........	1839·67	336·15	0·70
Secchi.........	1857·52	324·97	0·38
Talmage	1865·76	295·56	...

Cephei 318. Σ 13.

R. A. (1860) $0^h\ 8^m\ 18^s$.
Dec. N. 76° 10′.
Mags. $a = 6$, $b = 6\frac{1}{2}$.
Colours: Secchi, 1857, both white.

Struve	1831·50	124·02	0·53
Mädler	1840·82	118·01	0·52
Secchi.........	1857·52	102·28	0·69
Dembowski ..	1863·00	103·56	0·50

η Cassiopeæ. Σ 60.

R. A. $0^h\ 40^m\ 52^s$. Dec. N. 57° 6′ 2″.
Mags. $a = 4$, $b = 7\frac{1}{2}$.
Colours: Smyth, 1843, p. whi., purp.; Webb, 1850, yel., p. garnet; Main, 1861, white, lilac.

Struve.........	1819·80	80·12	10·80
Smyth.........	1830·91	87·80	9·80
,, ...	1854·17	108·30	7·70
Dawes.........	1854·00	109·60	7·91
Secchi	1857·14	112·84	7·85
Dembowski ..	1865·18	125·66	6·72
Knott	1865·69	125·59	6·75

Orbital period about 700 yrs. (Smyth).

36 Andromedæ. Σ 73.

R. A. $0^h\ 47^m\ 36^s$. Dec. N. 22° 53′ 53″.
Mags. $a = 6$, $b = 7$.
Colours: Smyth, 1843, br. oran., yel.; Webb, 1850, Main, 1861, both yel.

Herschel......	1830·78	307·04	0·90
Struve.........	1832·44	307·80	0·84
Smyth.........	1835·92	315·70	1·10
,, ...	1852·83	335·80	1·30
Dawes.........	1859·83	340·28	1·19
Main	1861·80	329·00	1·10
Dembowski ..	1865·25	345·44	1·21
Knott	1865·69	344·85	1·35
Talmage......	1865·77	346·48	1·06
Secchi.........	1866·05	349·51	1·31

P. 0. 251 Piscium.

R. A. $0^h\ 52^m\ 29^s$. Dec. N. 0° 13′ 3″.
Mags. $a = 8$, $b = 9$.
Colours: Smyth, 1838, p. orange, bl.

	Epoch.	Position.	Distance.
		°	″
South	1825·17	296·27	18·87
Smyth	1832·98	299·80	18·40
,, ...	1838·03	301·80	18·50
,, ...	1852·81	305·10	18·80

42 Ceti. Σ 113.

R. A. $1^h\ 12^m\ 54^s$. Dec. S. 1° 14′ 4″.
Mags. $a = 6$, $b = 8$.
Colours: Smyth, 1834, br. wh., white; Dembowski, 1863, both white.

Smyth.........	1834·84	332·80	1·20
Struve.........	1836·91	334·30	1·77
Smyth.........	1857·97	344·60	1·30
Dawes.........	1854·51	338·47	1·16
Secchi.........	1856·48	339·75	1·16
Main	1861·90	357·43	0·90
Dembowski ..	1863·03	343·03	1·27

P. I. 123 Piscium. Σ 138.

R. A. $1^h\ 28^m\ 59^s$. Dec. N. 6° 57′ 15″.
Mags. $a = 6\frac{1}{2}$, $b = 8$.
Colours: Smyth, 1843, yel., p. white; Webb, 1855, yellow; Main, 1862, deep yellow.

Struve.........	1830·23	20·00	1·46
Smyth.........	1832·86	19·80	1·50
,, ...	1853·91	26·30	1·50
Dawes.........	1853·81	29·38	1·26
Secchi.........	1857·89	29·10	1·45
Main	1862·02	30·28	1·24
Dembowski ..	1863·17	28·69	1·57

P. 1. 209 Piscium. Σ 186.

R. A. (1860), $1^h\ 47^m\ 0^s$.
Dec. N. 0° 59′ 0″.
Mags. $a = 7\frac{1}{2}$, $b = 7\frac{1}{2}$.
Colours: Secchi, 1857, both white.

Struve.........	1831·12	64·72	1·23
Secchi.........	1857·92	267·52	0·42
Dawes.........	1863·85	85·15	0·30

There is evidently an error of 180° in one of these measures. Smyth in 1833 has P =62·9, D =1·5.

a PISCIUM. Σ 202.

R. A. $1^h\ 55^m\ 3^s$. Dec. N. 2° 6′ 39″.
Mags. $a = 5$, $b = 6$.
Colours: Smyth, 1846, p. gr., blue.

	Epoch.	P.	D.
		°	″
Herschel ...	1779·80	337·23	5·12
Smyth	1834·92	334·70	3·60
„	1846·92	331·40	3·50
„	1852·03	329·50	3·50
Dawes.........	1853·99	328·10	3·42
Secchi.........	1856·16	327·87	3·35
Jacob	1858·05	326·82	3·19
Morton	1858·70	326·46	3·51
Main	1861·90	329·36	3·15
Dembowski ..	1863·95	326·28	3·13
Knott	1865·47	325·76	3·23
Talmage......	1865·76	324·90	3·48

γ ANDROMEDÆ. Σ 205.

R. A. $1^h\ 55^m\ 37^s$. Dec. N. 41° 40′ 55″.
A : B.
Mags. $a = 3\frac{1}{2}$, $b = 5\frac{1}{2}$.
Colours: Smyth, 1843, ora., em. gr.

Struve	1830·02	62·44	10·33
Dawes.........	1832·94	64·05	10·63
Smyth.........	1843·33	61·60	11·00
Secchi.........	1858·58	62·79	10·30
Main	1861·85	62·24	9·58
Dembowski ..	1862·96	62·97	10·42
Romberg ...	1863·13	62·65	10·32
Dawes.........	1863·86	64·20	10·47
Morton	1859·76	63·11	10·34
Talmage......	1865·81	62·70	9·47
Knott	1865·67	63·43	10·36

B : C. $b = 5$, $c = 6·3$.
Colours: Smyth, p. yel., smalt blue.

Struve.........	1842·72	126·36	...
Smyth.........	1852·99	115·00	0.50
Mädler	1855·02	119·42	...
Secchi.........	1858·99	108·52	0·45
Dawes	1863·86	107·70	0·59
Romberg ...	1863·99	107·58	0·60
Dembowski ..	1865·64	105·40	0·50
Knott	1865·67	107·07	0·59
Talmage......	1865·76	106·35	0·58

259 ANDROMEDÆ. Σ 228.

R. A. (1860), $2^h\ 5^m\ 6^s$.
Dec. N. 46° 50′.
Mags. $a = 7$, $b = 7$.
Colours: Secchi, 1857, both yellow.

	Epoch.	P.	D
Struve	1831·46	262·14	1·08
Mädler	1836·61	267·18	1·03

259 ANDROMEDÆ (*continued*).

		°	″
Secchi.........	1857·62	286·86	0·99
Dembowski ..	1862·96	286·50	0·90

Σ 257 PERSEI.

R. A. (1860), $2^h\ 15^m\ 12^s$.
Dec. N. 60° 55′.
Mags. $a = 7$, $b = 8$.
Colours: Secchi, 1857, yellow, white.

Struve.........	1830·53	164·93	0.60
Mädler	1837·38	170.90	0.56
Secchi.........	1857·48	183·34	0.40
Dembowski ..	1863·13	183.50	...

ι CASSIOPEÆ. Σ 262.

R. A. (1860), $2^h\ 17^m\ 35^s$.
Dec. N. 66° 46′.
A : B.
Mags. $a = 4\frac{1}{2}$, $b = 7$.
Colours: Secchi, 1857, both yellow.

Struve.........	1829·66	276·68	1·86
Mädler	1831·64	275·33	1·88
Dawes..... ...	1848·09	265·50	2·24
Morton	1856·03	265·40	2·01
Secchi.........	1857·49	266·88	1·83
Dembowski ..	1862·99	265·87	1·92
Romberg ...	1863·95	268·77	1·72

Σ 278 CASSIOPEÆ.

R. A. (1860), $2^h\ 25^m\ 36^s$.
Dec. N. 68° 41′.
Mags. $a = 8$, $b = 8\frac{1}{2}$.
Colours: Secchi, 1857, both white.

Struve.........	1830·77	82·05	0·43
Secchi.........	1857·93	67·67	0·40

114 ARIETIS. Σ 305.

R. A. 1860, $2^h\ 39^m\ 36^s$.
Dec. N. 18° 46′.
Mags. $a = 7$, $b = 8$.
Colours: Secchi, 1858, both white.

Struve.........	1830·95	330·87	1·58
Dawes...	1853·89	322·48	2·33
Secchi.........	1857·89	322·23	2·56
Dembowski ..	1863·09	321·78	2·52

ε ARIETIS. Σ 333.

R. A. $2^h\ 51^m\ 29^s$.
Dec. N. 20° 47′ 57″.
Mags. $a = 5$, $b = 6\frac{1}{2}$.
Colours: Smyth, 1863, p. yel., whitish; Dembowski, 1863, white.

	Epoch.	P.	D.
		°	″
Struve………	1830·16	188·87	0·54
Smyth ……	1835·77	193·50	0·50
” ……	1853·08	200·10	1·00
Dawes………	1854·00	195·55	1·01
Secchi………	1856·57	196·73	0·87
Dembowski ..	1862·99	194·72	0·80
Knott………	1866·64	199·06	1·14

7 TAURI. Σ 412.

R. A. 1860, $3^h\ 26^m\ 0^s$.
Dec. N. 23° 59′.
A : B.
Mags. $a = 6\frac{1}{2}$, $b = 6\frac{1}{2}$.
Colours: Secchi, 1856, both white.

Struve………	1830·38	269·92	0·69
Smyth ……	1833·21	265·00	0·70
Mädler ……	1839·76	265·50	0·55
Dawes………	1846·91	259·92	0·65
Secchi………	1856·35	256·78	0·42
Dembowski ..	1863·08	257·90	…
Knott………	1864·93	240·80	0·50
Talmage……	1865·71	261·97	…

P. III. 98 ERIDANI.

R. A. $3^h\ 29^m\ 52^s$.
Dec. N. 0° 8′ 49″.
Mags. $a = 6\frac{1}{2}$, $b = 9$.
Colours: Smyth, 1845, yel., p. blue.

South………	1824·02	225·12	5·81
Smyth………	1834·93	231·80	5·90
” ………	1845·81	235·90	6·00

49 CEPHEI. Σ 460.

R. A. (1860), $3^h\ 46^m\ 48^s$.
Dec. N. 80° 18′.
Mags. $a = 5\frac{1}{2}$, $b = 6\frac{1}{2}$.
Colours: Secchi, 1857, both white.

Struve………	1830·89	352·56	0·88
Mädler ……	1836·76	356·75	0·87
Secchi………	1857·90	10·79	0·72
Dembowski ..	1862·95	15·61	0·70

Σ 511 CAMELOPARDI.

R. A. (1860), $4^h\ 6^m\ 12^s$.
Dec. N. 58° 2′ 36″.
Mags. $a = 6$, $b = 7$.
Colours: Secchi, 1858, yel., p. green.

	Epoch.	P.	D.
		°	″
Struve………	1829·52	320·00	0·54
Secchi………	1858·01	302·02	…
Dembowski ..	1863·61	294·07	…

TAURI 230. Σ 535.

R. A. 1860, $4^h\ 15^m\ 42^s$.
Dec. N. 11° 0′.
Mags. $a = 7$, $b = 8$.
Colours: Secchi, 1857, both white.

Struve………	1831·34	353·88	1·94
Dawes………	1854·29	342·73	2·06
Secchi………	1856·51	345·01	1·54
Morton ……	1860·01	345·58	1·60
Dembowski ..	1862·99	342·38	1·73

2 CAMELOPARDI. Σ 566.

R. A. (1860), $4^h\ 28^m\ 6^s$.
Dec. N. 53° 14′.
Mags. $a = 5\frac{1}{2}$, $b = 8\frac{1}{2}$.
Colours: Secchi, 1858, yellow, blue.

Struve………	1829·79	311·40	1·58
Mädler ……	1834·96	309·22	1·55
Smyth………	1836·28	308·70	1·70
Secchi………	1858·92	300·55	1·73
Dembowski ..	1863·24	299·53	1·68

Σ 577 AURIGÆ.

R. A. (1860), $4^h\ 32^m\ 48^s$.
Dec. N. 37° 14′.
Mags. $a = 7\frac{1}{2}$, $b = 8$.
Colours: Secchi, 1857, both white.

Struve………	1829·57	278·88	1·58
Mädler ……	1835·81	274·19	1·64
Secchi………	1857·65	267·99	1·63
Dembowski ..	1862·77	265·50	1·62

η ORIONIS. D 5.

R. A. $5^h\ 17^m\ 26^s$. Dec. S. 2° 31′ 48″.
Mags. $a = 4$, $b = 5$.
Colours: white, purplish.

Herschel …	1781·99	single?	
Dawes………	1848·04	87·00	1·00
” ………	1866·95	86·12	0·95
Knott………	1863·12	88·92	0·94
” ………	1866·94	89.83	1·02

Σ 932 GEMINORUM.

R. A. $6^{h}\ 26^{m}\ 24^{s}$. Dec. N. 14° 51′.
Mags. $a = 8$, $b = 8\frac{1}{2}$.
Colours: Secchi (1857), both white.

	Epoch.	P.	D.
		°	″
Struve.........	1830·53	341·70	2·42
Mädler	1837·51	339·56	2·53
Secchi.........	1857·16	334·38	2·04
Dawes.........	1859·15	332·07	2·56
Dembowski ..	1863·41	333·27	2·26

12 LYNCIS. Σ 948.

R. A. $6^{h}\ 34^{m}\ 18^{s}$.
Dec. N. 59° 34′ 26″.

A : B.

Mags. $a = 6$, $b = 6\frac{1}{2}$.
Colours: Smyth, 1839, white, ruddy.

Herschel......	1780·68	181·23	1·50
Struve.........	1831·10	153·70	1·53
Smyth.........	1832·96	154·30	1·60
"	1839·27	149·50	1·60
Dawes.........	1848·22	143·35	1·69
Smyth.........	1852·96	143·70	1·50
Secchi.........	1857·30	142·27	1·68
Morton	1858·24	140·15	1·55
Main	1862·31	136·18	1·53
Dembowski ..	1863·05	138·57	1·72
Kaiser*	1866·28	316·50	1·64

* This measure is evidently too large by 180°.

A : C. $c = 7\frac{1}{2}$, bluish.

Herschel......	1780·68	302·33	9·38
Struve.........	1831·10	304·20	8·67
Smyth.........	1832·96	305·10	8.60
Dawes.........	1833·13	304·06	8·88
Smyth.........	1852·96	306·30	9·00
Secchi.........	1857·30	305·50	8·66
Morton	1858·24	305·90	8·56
Main	1862·31	303·58	8·97
Dembowski ..	1863·06	305·77	8.67

Orbital period about 700 years.

a CANIS MAJORIS (Sirius).

R. A. (1860) $6^{h}\ 39^{m}\ 13^{s}$.
Dec. S. 16° 31′ 47″.
Mags. $a = 1$, b 10.
Colours: *a* white, *b* ... ?

Bond	1862·10	85·15	10·37
Dawes.........	1864·22	84·86	10·00
Lassell	1864·20	80·15	9·67
Struve, O. ...	1864·22	74·80	10·92
Knott	1866·08	77·15	10·43
Secchi.........	1866·28	71·31	10·10

38 GEMINORUM. Σ 982.

R. A. $6^{h}\ 47^{m}\ 1^{s}$. Dec. N. 13° 20′ 56″.
Mags. $a = 5\frac{1}{2}$, $b = 8$.
Colours: Smyth, 1849, light yellow, purple; Dawes, yellow, blue.

	Epoch.	P.	D.
		°	″
Herschel......	1781·99	179·54	7·95
Struve.........	1829·24	174·88	5·73
Smyth.........	1836·10	171·80	6·00
"	1849·19	170·20	5·60
Fletcher	1851·89	168·87	6·25
Morton	1854·14	168·58	5·99
Dawes.........	1854·17	167·49	5·86
Secchi.........	1856·11	169·30	6·13
Powell	1861·12	165·30	6·07
Dembowski ..	1863·02	166·30	6·13
Main	1863·14	167·48	5·96
Romberg ...	1863·11	167·28	6·36

Σ 1037 GEMINORUM.

R. A. (1860), $7^{h}\ 4^{m}\ 6^{s}$.
Dec. N. 27° 27′ 36″.
Mags. $a = 7$, $b = 7\frac{1}{2}$.
Colours: Secchi, 1856, both white.

Struve.........	1830·42	332·67	1·11
Mädler	1841·80	331·10	1·33
Dawes.........	1848·17	324·67	1·32
Secchi.........	1856·67	323·07	1·24
Dembowski ..	1863·20	318·10	1·22

a GEMINORUM. Σ 1110.

R. A. $7^{h}\ 25^{m}\ 59^{s}$.
Dec. N. 32° 11′.
Mags. $a = 3$, $b = 3\frac{1}{2}$.
Colours: Smyth, 1843, white, p. wh.; Webb, 1854, white; Main, 1863, yellow.

Herschel......	1778·27	302·47	5·16
Smyth.........	1830·95	258·80	4·70
"	1849·17	248·10	4·90
Secchi.........	1855·82	245·13	5·36
Main	1863·14	239·00	5·39
Dembowski ..	1863·03	241·66	5·38
Knott	1865·04	239·71	5·42
Dawes.........	1865·31	241·45	5·68
Talmage......	1866·13	237·36	5·37

Perihelion passage, 1855 (H).

Σ 1157 MONOCEROTIS.

R. A. (1860), $7^h 47^m 30^s$.
Dec. S. 2° 26′.
Mags. $a = 8$, $b = 8·3$.
Colours: Secchi, 1856, both white.

	Epoch.	P.	D.
		°	″
Struve.........	1831·20	267·27	1·59
Secchi.........	1856·47	256·44	1·30
Dembowski ..	1863·11	256·77	1·29

85 LYNCIS. Σ 1187.

R. A. (1860), $8^h 0^m 42^s$.
Dec. N. 32° 37′.
Mags. $a = 8$, $b = 7\frac{1}{2}$.
Colours: Secchi, both white.

Struve.........	1829·50	71·00	1·61
Mädler	1837·69	68·25	1·62
Secchi.........	1858·21	61·65	1·75
Morton	1860·28	55·28	1·83
Dembowski ..	1863·15	56·28	1·83

ζ CANCRI. Σ 1196.

R. A. $8^h 4^m 28^s$.
Dec. N. 18° 3′ 14″.
A : B.
Mags. $a = 6$, $b = 7$.
Colours: Smyth, 1843, yel., orange;
Webb, 1849, yellow.

Herschel......	1781·90	3·28	1·00
Smyth.........	1832·23	28·30	1·30
,, ...	1853·17	322·70	0·90
Fletcher	1853·30	321·06	1·10
Secchi.........	1857·28	303·92	0·77
Dembowski ..	1864·15	255·02	0·50
Dawes.........	1865·30	243·42	0·63
Knott	1866·26	233·63	0·78
Secchi.........	1866·28	234·62	0·40

Perihelion passage, 1853.

A: C. $c = 7\frac{1}{2}$.

Herschel......	1781·90	181·44	8·05
Smyth.........	1832·23	149·40	5·40
Fletcher	1852·49	143·68	4·84
Smyth.........	1853·17	144·10	4·80
Dawes.........	1854·07	140·47	5·05
Dembowski ..	1865·17	139·72	5·46
Secchi.........	1866·28	140·70	5·61

P. VIII. 13 CANCRI. Σ 1202.

R. A. (1860), $8^h 5^m 54^s$.
Dec. N. 11° 16′.
Mags. $a = 8$, $b = 10$.
Colours: a white, b ... ?

	Epoch.	P.	D.
		°	″
Struve.........	1829·55	335·93	2·35
Dawes.........	1848·24	328·57	2·22
Secchi.........	1856·17	325·27	2·06
Dembowski ..	1863·12	327·45	2·50

ε HYDRÆ. Σ 1273.

R. A. $8^h 39^m 38^s$.
Dec. N. 6° 54′ 53″.
Mags. $a = 4$, $b = 8\frac{1}{2}$.
Colours: Smyth, 1843, p. yel., purp.;
Webb, 1857, yel., ruddy; Main,
1863, yellow, pale purple.

Struve.........	1830·60	195·58	3·33
Smyth.........	1837·11	198·40	3·40
Dawes.........	1851·32	208·48	3·44
Fletcher	1852·96	208·52	3·57
Main	1863·17	200·53	3·40
Dembowski ..	1863·13	212·90	3·47
Secchi.........	1865·27	215·60	3·47
Talmage......	1866·14	213·83	3·87

Orbital period about 450 yrs. (Smyth).

157 LYNCIS. Σ 1338.

R. A. (1860) $9^h 12^m 12^s$.
Dec. N. 38° 46′ 42″.
Mags. $a = 6\frac{1}{2}$, $b = 7$.
Colours: Secchi, both white.

Struve.........	1829·53	121·14	1·76
Mädler	1838·10	127·10	1·69
Dawes.........	1854·20	134·64	1·65
Morton	1854·24	137·30	1·92
Secchi.........	1856·30	137·18	1·63
Dembowski ..	1863·28	140·95	1·59
Talmage	1866·10	142·48	1·71

ω LEONIS. Σ 1356.

R. A. $9^h 21^m 13^s$. Dec. N. 9° 38′ 36″.
Mags. $a = 6\frac{1}{2}$, $b = 7\frac{1}{2}$.
Cols.: Smyth, 1843, p. yel., greenish.

Herschel......	1783·26	110·54	0·40
Smyth.........	1832·11	160·00	0·50
,, ...	1843·14	193·00	0·30
Dawes.........	1854·23	346·23	0·55
Secchi.........	1856·42	0·99	0·35
,, ...	1866·29	32·92	0·30

Perihelion passage, 1849.

P. IX. 161 Sextantis. Σ 1377.

R. A. (1860), $9^h\ 36^m\ 6^s$.
Dec. N. 3° 16′.
Mags. $a = 8$, $b = 10$.
Colours: Smyth, 1834, yellowish white, blue.

	Epoch.	P.	D.
		°	″
Struve.........	1830·24	142·20	3·31
Smyth.........	1834·26	145·00	4·00
Mädler	1836·41	140·61	3·37
Secchi.........	1856·27	129·45	3·11

φ Ursæ Majoris. O Σ 208.

R. A. $9^h\ 41^m\ 10^s$. Dec. N. 54° 49′.
Mags. $a = 5$, $b = 5\frac{1}{2}$.
Colours:

Struve, O. ...	1842·35	8·45	0·52
Dawes.........	1854·28	25·89	0·40
Secchi.........	1857·34	30·60	0·30
Struve, O. ...	1866·42	45·90	0·24

8 Sextantis. A C 5.

R. A. $9^h\ 45^m\ 6^s$.
Dec. S. 7° 24′ 0″.
Mags. $a = 6$, $b = 6\frac{1}{2}$.
Colours: Dawes, both white.

Dawes.........	1854·20	50·54	0·55
,, ...	1860·34	38·21	0·50

γ Leonis. Σ 1424.

R. A. $10^h\ 12^m\ 30^s$.
Dec. N. 20° 31′ 35″.
Mags. $a = 2$, $b = 4$.
Colours: Smyth, 1843, bri. orange, greenish yel.; Webb, 1849, yellow, greenish yel.; Main, 1862, yellow, greenish.

Herschel......	1782·71	83·30	3·00
Struve.........	1832·75	103·46	2·50
Smyth.........	1833·20	102·50	2·80
,, ...	1843·18	107·20	2·80
Fletcher	1853·21	108·43	3·00
Main	1862·35	107·19	3·10
Dembowski ..	1863·28	109·29	2·85
Secchi.........	1865·04	110·29	3·18
Dawes.........	1865·40	110·30	3·17
Knott	1866·21	110·49	3·21
Talmage......	1866·20	111·44	3·17

Leonis 145. Σ 1426.

R. A. (1860), $10^h\ 13^m\ 12^s$.
Dec. N. 7° 8′.
A : B.
Mags. $a = 8$, $b = 7\frac{1}{2}$.
Colours: Secchi, both pale yellow.

	Epoch.	P.	D.
		°	″
Struve.........	1832.26	256·77	0·62
Dawes.........	1854·16	263·28	0·88
Secchi.........	1856.15	271·78	0·65

Σ 1457 Sextantis.

R. A. (1860), $10^h\ 31^m\ 24^s$.
Dec. N. 6° 28′.
Mags. $a = 7\frac{1}{2}$, $b = 8$.
Colours: Secchi, 1856, both p. yell.

Struve.........	1829·55	287·85	0·71
Mädler	1837·53	299·51	0·74
Dawes.........	1850·78	302·75	0·92
Secchi.........	1856·24	307·55	0·76
Morton	1857·28	312·58	0·60
Dembowski ..	1863·20	309·83	0·91

Σ 1516 Draconis.

R. A. (1860), $11^h\ 5^m\ 42^s$.
Dec. N. 74° 15′.
Mags. $a = 7$, $b = 7\frac{1}{2}$.
Colours: Secchi, 1856, both white.

Struve.........	1831·54	298·70	9·93
,, ...	1835·56	301·67	8·42
Dembowski ..	1854·55	8·35	2·70
Secchi.........	1856·29	29·55	2·61
Morton	1860·21	56·33	3·24
Dembowski ..	1863·35	70·05	4·14

ξ Ursæ Majoris. Σ 1523.

R. A. $11^h\ 10^m\ 59^s$.
Dec. N. 32° 17′ 39″.
Mags. $a = 4$, $b = 5\frac{1}{2}$.
Colours: Smyth, 1843, white; Webb, 1848, white; Main, 1863, white.

Herschel......	1780·33	143·47	3·50
Struve.........	1827·26	229·30	1·82
Smyth.........	1835·37	180·20	1·90
,, ...	1851·31	123·50	2·90
Fletcher	1857·40	111·25	2·99
Dawes.........	1860·32	105·21	2·88
,, ...	1864·50	93·96	2·42
Dembowski ..	1864·83	91·96	2·23
Secchi.........	1864·38	92·88	2·40
,, ...	1865·51	89·88	2·53
,, ...	1866·30	86·55	2·25
Kaiser	1866·45	87·80	2·08

Perihelion passage, 1816.

ι LEONIS. Σ 1536.

R. A. $11^h\ 16^m\ 53^s$.
Dec. N. 11° 16′ 36″.
Mags. $a = 4$, $b = 7\frac{1}{2}$.
Colours: Smyth, 1843, pale yellow, light blue; Webb, 1849, pale yell., pale blue; Main, 1862, yell. blue.

	Epoch.	P.	D.
		°	″
Struve.........	1827·28	97·00	2·30
Smyth.........	1836·40	90·50	2·40
„	1853·29	81·30	2·50
Main	1862·25	73·54	2·72
Dembowski ..	1863·23	76·70	2·51
Secchi.	1865·27	76·55	2·88
Dawes.........	1865·40	72·13	2·81
Talmage......	1866·31	75·58	3·17

VIRGINIS 191. Σ 1647.

R. A. 1860, $12^h\ 23^m\ 30^s$.
Dec. N. 10° 49′.
Mags $a = 7\frac{1}{2}$, $b = 8$.
Colours: Secchi, 1856, both white.

Struve.........	1830·07	202·04	1·18
Mädler	1835·06	204·23	1·20
Dawes.........	1850·66	211·72	1·23
Secchi.........	1856·35	211·67	1·19
Dembowski ..	1863·24	212·90	1·39

γ VIRGINIS. Σ 1670.

R. A. $12^h\ 34^m\ 50^s$.
Dec. S. 0° 42′ 34″.
Mags. $a = 4$, $b = 4$.
Colours: Smyth, 1843, silvery whi., pale yell.; Webb, 1851, yellowish white; do. 1863, pale yell.; Main, 1863, white.

Mayer.........	1756·00	144·22	6·50
Herschel......	1780·06	130·44	5·70
Struve.........	1825·32	277·92	2·37
Smyth.........	1831·38	74·90	1·60
„	1837·21	265·40	0·60
„	1843·33	191·60	1·90
Fletcher	1858·38	170·01	3·56
Smyth.........	1858·39	169·90	3·80
Main	1863·30	164·35	4·05
Secchi.........	1864·41	165·54	4·28
Dawes.........	1865·42	164·02	4·37
Dembowski ..	1865·43	164·10	4·04
Knott	1865·45	164·33	4·33
Secchi.........	1866·31	164·28	4·39
Talmage......	1866·36	162·40	4·51
Main	1866·44	164·92	4·34

Perihelion passage, 1836.

35 COMÆ BERENICIS. Σ 1687.

R. A. $12^h\ 46^m\ 39^s$.
Dec. N. 21° 58′ 49″.
A : B.
Mags. (Secchi), $a = 5\frac{1}{2}$, $b = 8\frac{1}{2}$.
Colours: Smyth, 1843, pale yell., lilac; Secchi, 1856, yellow, blue.

	Epoch.	P.	D.
		°	″
Struve.........	1829·99	25·39	1·43
Smyth.........	1834·38	30·00	1·00
„	1843·32	42·00	1·50
Secchi.........	1856·40	41·45	1·31
Morton	1856·34	50·13	1·32
Dawes.........	1860·34	47·68	1·44
Dembowski ..	1863·26	50·33	1·30
Knott	1865·31	52·87	1·31

42 COMÆ BERENICIS. Σ 1728.

R. A. $13^h\ 3^m\ 26^s$.
Dec. N. 18° 14′ 34″.
Mags. $a = 4\frac{1}{2}$, $b = 5$.
Colours: Smyth, 1842, both p. yell.; Dembowski, 1863, both white.

Struve.........	1827·83	*9·50	0·64
„	1836·41	190·20	0·30
Smyth.........	1842·50	*5·00	0·30
Secchi.........	1856·96	192·45	0·47
Morton	1856·28	190·44	0·65
Dembowski ..	1863·23	189·10	...
Dawes.........	1864·43	193·41	0·36
Secchi.........	1865·53	193·95	0·25

* These measures should perhaps be +180.

P. XIII. 127 VIRGINIS. Σ 1757.

R. A. $13^h\ 27^m\ 23^s$.
Dec. N. 0° 22′ 38″.
Mags. $a = 8$, $b = 9$.
Colours: Smyth, 1843, pale white, yellowish; Secchi, 1856, white.

Struve.........	1825·37	10·00	1·60
Smyth.........	1842·52	37·90	1·70
„	1852·38	51·70	2·00
Secchi.........	1856·88	52·94	1·84
Dawes.........	1860·34	54·31	2·31
Dembowski ..	1863·32	59·04	2·00

Orbital period about 240 years, Smyth.

25 CANUM VENATICORUM. Σ 1768.

R. A. (1860), $13^h\ 29^m\ 54^s$.
Dec. N. 37° 11′.
Mags. $a = 5·7$, $b = 7·6$.
Colours: Struve, white, blue.

	Epoch.	P.	D.
		°	″
Struve	1831·51	76·50	1·07
Mädler	1839·25	71·30	1·06
Dawes	1854·43	36·26	0·35
Secchi	1856·48	25·75	...
Dawes	1865·44	round	...

Σ 1785 BOOTIS.

R. A. (1860), $13^h\ 42^m\ 48^s$.
Dec. N. 27° 41′.
Mags. $a = 7$, $b = 7\frac{1}{2}$.
Colours: Secchi, 1856, both white.

Struve	1830·12	164·43	3·48
Mädler	1840·85	172·10	3·47
Secchi	1856·36	185·97	3·24
Morton	1859·29	185·24	2·89
Main	1863·31	191·15	2·78
Dembowski	1864·97	192·41	2·60

Σ 1819 VIRGINIS.

R. A. (1860), $14^h\ 8^m\ 18^s$.
Dec. N. 3° 47′.
Mags. $a = 7\frac{1}{2}$, $b = 8$.
Colours: Secchi, 1859, both white.

Struve	1830·39	84·90	0·98
„	1836·43	76·12	1·12
Dawes	1843·34	61·92	1·02
Secchi	1859·45	39·45	1·00
Dembowski	1863·01	32·35	1·29

Σ 1830 BOOTIS.

R. A. (1860), $14^h\ 11^m\ 12^s$.
Dec. N. 57° 19′.
Mags. $a = 8\frac{1}{2}$, $b = 9$.
Colours: Secchi, 1860, white, blue.

Struve	1830·89	264·00	4·84
Mädler	1838·19	267·60	5·11
Secchi	1860·06	278·23	5·30

π BOOTIS. Σ 1864.

R. A. $14^h\ 34^m\ 22^s$.
Dec. N. 16° 59′ 57^s.
Mags. $a = 3\frac{1}{2}$, $b = 6$.
Colours: Smyth, 1836, both white.

	Epoch.	P.	D.
		°	″
Herschel	1779·72	96·28	6·17
South	1822·05	97·53	6·90
Struve	1830·32	99·20	5·83
Smyth	1836·51	99·30	6·00
Secchi	1856·79	100·93	5·97
Morton	1857·34	100·36	6·13
Main	1861·31	100·80	6·18
Romberg	1863·27	101·82	6·01
Kaiser	1866·45	100·60	5·73

Σ 1876 LIBRÆ.

R. A. (1860), $14^h\ 39^m\ 0^s$.
Dec. S. 6° 48′.
Mags. $a = 8$, $b = 8$.
Colours: Secchi, 1856, both white.

Struve	1832·33	51·73	1·18
Secchi	1856·87	60·84	1·00
Dembowski	1863·39	65·87	1·20

ε BOOTIS. Σ 1877.

R. A. $14^h\ 39^m\ 5^s$.
Dec. N. 27° 38′ 40″.
Mags. $a = 3$, $b = 7$.
Colours: Smyth, 1838, pale orange, sea-green; Webb, 1850, light yell., greenish; Main, 1862, orange, greenish; Secchi, 1855, yell., blue; Struve, 1856, yellow, blue; Dembowski, 1865, yellow, blue.

Herschel	1779·67	301·34	4·00
Struve	1829·39	320·58	2·64
Smyth	1831·46	321·60	3·20
„	1848·54	322·10	2·80
Secchi	1855·37	323·58	2·60
Main	1862·39	324·24	2·60
Dembowski	1864·81	324·70	2·71
Dawes	1865·48	325·50	2·92
Secchi	1865·48	324·70	3·29

Orbital period about 980 years,
Smyth.

ξ BOOTIS. Σ 1888.

R. A. 14^h 45^m 9^s.
Dec. N. 19° 39′ 48″.
Mags. a = 3½, b = 6½.

Colours: Smyth, 1842, oran., purp.; Webb, 1850, clear yellow, reddish purple; Main, 1862, straw-colour and reddish.

	Epoch.	P.	D.
		°	″
Herschel......	1780·28	24·07	3·42
Struve.........	1829·46	334·11	7·22
Smyth.........	1831·53	332·10	7·30
„	1842·42	322·90	6·90
„	1852·38	316·80	6·50
Dawes.........	1854·46	311·98	6·26
Secchi	1856·88	310·05	6·01
Main	1862·33	305·53	5·68
Dembowski ..	1864·91	301·58	5·44
Secchi	1865·77	300·82	5·41
Talmage......	1866·48	298·53	5·09

Perihelion passage, 1779.

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44 BOOTIS. Σ 1909.

R. A. 14^h 59^m 21^s.
Dec. N. 48° 10′ 51″.
Mags. a = 5, b = 6.

Colours: Smyth, 1842, white, grey; Main, 1862, yellowish; Webb, 1865, pale yellow, tawny.

Herschel......	1781·62	60·06	1·50
Struve.........	1832·24	234·01	2·86
Smyth.........	1839·62	235·30	3·50
„	1847·45	236·20	4·10
Fletcher	1851·47	237·95	4·26
Dawes.........	1854·74	237·77	4·58
Secchi.........	1856·40	238·80	4·55
Main	1862·42	238·30	4·61
Dembowski ..	1863·31	239·53	4·75

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1 CORONÆ BOREALIS. Σ 1932.

R. A. (1860), 15^h 12^m 18^s.
Dec. N. 27° 21′.
Mags. a = 6, b = 6½.

Colours: Secchi (1856), both white.

Struve.........	1830·28	273·85	1·62
Mädler	1839·52	278·47	1·53
Dawes.........	1854·40	284·07	1·36
Secchi.........	1856·40	285·37	1·14
Dembowski ..	1863.28	290·27	1·18

η CORONÆ BOREALIS. Σ 1937.

R. A. 15^h 17^m 37^s.
Dec. N. 30° 46′ 44″.
Mags. a = 6, b = 6½.

Colours: Smyth, 1842, white, golden yellow; Webb, white, yell.; Dembowski, 1863, white.

	Epoch.	P.	D.
		°	″
Herschel......	1781·61	30·41	1·00
Struve.........	1826·76	35·16	1·08
Smyth.........	1832·63	57·20	0·80
„	1842·58	151·30	0·50
„	1852·43	246·80	0·50
Secchi.........	1858·51	359·19	0·53
Dembowski ..	1863·03	19·04	0·81
„ ..	1865·49	27·40	1·02
Dawes.........	1865·44	27·52	1·07
Secchi.........	1865·50	26·26	0·79
„	1866·53	33·13	1·12

Perihelion passage, 1830.

μ^2 BOOTIS (P. XV. 74). Σ 1938.

R. A. 15^h 19^m 25^s.
Dec. N. 37° 49′ 18″.
Mags. a = 8, b = 8½.

Colours: Smyth, 1842, greenish wh.; Secchi, 1856, white, blue.

Herschel......	1782·68	357·14	1·50
Struve.........	1829·73	324·05	1·25
Smyth.........	1832·31	321·40	1·30
„	1842·52	306·10	0·80
„	1853·60	255·00	0·50
Secchi.........	1857·44	231·33	0·48
Romberg ...	1863·63	195·80	0·75
Knott	1864·41	193·64	0·50
Dawes.........	1865·46	190·07	0·48
Dembowski ..	1865·13	186·29	0·50
Secchi	1866·57	180·30	0·30

Perihelion passage, 1849.

δ SERPENTIS. Σ 1954.

R. A. 15^h 28^m 21^s.
Dec. N. 10° 59′ 32″.
Mags. a = 3, b = 5.

Colours: Smyth, 1842, bright white, bl. white; Main, 1862, both white.

Herschel......	1782·99	227·12	3·00
Struve.........	1802·10	208·50	...
South	1821·33	199·13	3·05
Smyth.........	1842·35	196·20	2·80
„	1851·32	196·50	3·00
Secchi	1855·88	195·52	3·06

[*Continued.*

δ SERPENTIS (*continued*).

	Epoch.	P.	D.
		°	″
Morton	1857·40	193·40	3·37
Main	1862·33	190·16	2·96
Dembowski ..	1863·43	192·20	3·19
Knott	1865·41	189·95	3·32
Kaiser	1865·54	192·30	3·18
Dawes.........	1865·55	191·22	3·24
Talmage	1866·45	189·80	3·42

γ CORONÆ BOREALIS. Σ 1967.

R. A. $15^h\ 37^m\ 4''$.
Dec. N. $26^\circ\ 43'\ 30''$.
Mags. $a = 4$, $b = 6\frac{1}{2}$.

Colours: Smyth, 1842, flushed wh., uncertain; Secchi, 1857, yellow, purple.

Struve.........	1826·75	111·05	0·72
Smyth.........	1839·69	225·00	0·30
,, ...	1848·37	295·00	0·50
Secchi.........	1857·51	289·32	0·36
Dawes.........	1858·96	281·46	0·47
Dembowski ..	1862·56	292·90	wedg'd
Secchi.........	1866·55	round.	

ξ SCORPII (=Fl. 51 LIBRÆ). Σ 1998.

R. A. $15^h\ 56^m\ 57^s$.
Dec. S. $10^\circ\ 59'\ 55''$.

A : B.

Mags. $a = 4\frac{1}{2}$, $b = 5$.

Colours: Smyth, 1842, bright white, pale yellow; Webb, 1856, yellow, yellowish green.

Herschel......	1782·36	7·58	1·50
Smyth.........	1834·42	6·60	1·40
,, ...	1842·56	23·50	1·20
,, ...	1846·49	24·90	1·00
Secchi.........	1855·54	53·60	0·47
Dembowski ..	1864·95	152·02	sep.
Dawes.........	1865·54	156·91	0·57
Secchi.........	1866·51	161·00	0·4±

A : C. $c = 7\frac{1}{2}$, grey.

Herschel......	1780·39	88·37	6·38
Smyth.........	1834·42	76·10	7·20
Dawes.........	1840·56	69·45	7·43
Smyth.........	1846·49	68·10	7·00
Secchi.........	1855·54	70·47	7·50
Main	1861·42	72·80	6·93
Dembowski ..	1865·38	71·02	7·11
Secchi*	1865·49	249·66	7·10

* Evidently should be −189°.

49 SERPENTIS. Σ 2021.

R. A. $16^h\ 7^m\ 0^s$.
Dec. N. $13^\circ\ 53'\ 37''$.
Mags. $a = 7$, $b = 7\frac{1}{2}$.

Colours: Smyth, 1839, pale white, yellowish; Main, 1862, both whi.

	Epoch.	P.	D.
		°	″
Herschel......	1783·18	291·33	2·50
South	1823·28	311·57	4·21
Struve.........	1832·70	316·41	3·20
Smyth.........	1839·29	318·10	3·30
Dawes.........	1849·44	321·27	3·3±
Smyth.........	1854·58	323·00	3·20
Morton	1855·48	322·41	3·65
Secchi.........	1856·01	332·35	3·45
Main	1862·37	323·43	3·53
Dembowski ..	1864·80	324·60	3·53

Orbital period, about 600 years.

Σ 2026 HERCULIS.

R. A. (1860), $16^h\ 7^m\ 48^s$.
Dec. N. $7^\circ\ 44''$.
Mags. $a = 8\frac{1}{2}$, $b = 9\frac{1}{2}$.

Colours: Secchi, 1856, both yellow.

Struve.........	1830·94	345·92	2·54
Mädler	1838·05	342·02	2·39
Secchi.........	1856·56	325·60	1·78
Dembowski ..	1865·39	326·10	1·50

σ CORONÆ BOREALIS. Σ 2032.

R. A. $16^h\ 9^m\ 37^s$.
Dec. N. $34^\circ\ 12'\ 12''$.

A : B.

Mags. $a = 6$, $b = 6\frac{1}{2}$.

Colours: Smyth, 1843, white, smalt-blue; Webb, 1856, yellow, bluish: Secchi, 1865, white, blue.

Herschel......	1802·74	11·24	...
Struve.........	1827·02	89·21	1·31
Smyth.........	1839·67	145·10	1·60
,, ...	1852·25	176·80	2·20
Secchi.........	1857·61	183·57	2·42
Dembowski ..	1864·95	191·24	2·79
Dawes.........	1865·38	191·48	3·08
Secchi.........	1865·81	192·45	2·97

Perihelion passage, 1826.

A : C. $c = 11$, dusky.

Smyth.........	1830·76	90·00	43·30
,, ...	1852·25	90·00	46·30
Secchi.........	1855·61	88·25	49·45
Dembowski ..	1862·60	88·35	51·04
Secchi.........	1866·62	87·10	...

a SCORPII (Antares).

R. A. $16^h\ 21^m\ 7^s$.
Dec. S. 26° 7′ 50″.
A : *a*.
Mags. $a = 1$, $b = 8$.
Colours: Secchi, red, blue.

	Epoch.	P.	D.
		°	″
Dawes………	1848·02	273·17	3·45
Secchi ……	1856·40	273·48	2·99
Smyth………	1857·40	270·00	3·50
Morton ……	1858·34	275·52	3·29
Powell ……	1861·09	271·90	…
Dawes………	1864·43	275·71	3·67
Dembowski ..	1865·56	270·43	2·99
Secchi ……	1866·00	272·90	2·92

λ OPHIUCHI. Σ 2055.

R. A. $16^h\ 24^m\ 6^s$.
Dec. N. 2° 16′ 53″.
Mags. $a = 4$, $b = 6$.
Colours: Smyth, yellowish, smalt-blue; Webb, yellowish, tawny.

Herschel……	1783·18	75·30	0·50
Struve………	1825·51	331·80	0·84
Smyth………	1834·48	351·20	1·00
” ………	1842·50	1·40	1·10
” ………	1853·25	15·50	1·20
Dawes………	1854·14	14·00	1·31
Secchi………	1857·50	19·88	1·33
Dawes………	1860·36	19·58	…
Secchi ……	1864·58	22·18	1·25
Dembowski ..	1865·49	25·26	1·51

Perihelion passage, 1798.

ζ HERCULIS. Σ 2084.

R. A. $16^h\ 36^m\ 12^s$.
Dec. N. 31° 50′ 41″.
Mags. $a = 3$, $b = 6$.
Colour: Smyth, 1842, yellowish wh., orange; Dembowski, 1863, *a* yell.; Secchi, 1858, yellow, violet.

Herschel……	1782·55	69·18	1·00
Struve………	1826·63	23·24	0·91
Smyth………	1835·68	190·00	0·50
” ………	1842·57	136·90	1·20
” ………	1852·53	83·80	1·30
Secchi ……	1858·47	54·59	1·06
Dembowski ..	1863·49	342·45	wedg'd
Secchi ……	1865·55	86·±	single
Dawes………	1866·81	229·22	0·83

Perihelion passage, 1825.

Σ 2106 OPHIUCHI.

R. A. (1860) $16^h\ 44^m\ 30^s$.
Dec. N. 9° 39′.
Mags. $a = 6·2$, $b = 7·8$.
Colours: Secchi, 1856, yell. wh., bl.

	Epoch.	P.	D.
		°	″
Struve………	1827·31	337·50	1·01
Secchi ……	1856·45	328·40	0·84
Dembowski ..	1863·53	321·30	0·50

HERCULIS 167. Σ 2107.

R. A. (1860), $16^h\ 46^m\ 18^s$.
Dec. N. 28° 54′.
Mags. $a = 6\frac{1}{2}$, $b = 8\frac{1}{2}$.
Colours: Secchi, 1856, yellow, blue.

Struve………	1829·91	148·63	1·12
Mädler ……	1842·10	161·70	1·03
Dawes………	1852·85	176·36	1·16
Secchi………	1856·59	175·43	0·97
Dembowski ..	1865·08	189·28	0·93

P. XVI. 270 OPHIUCHI. Σ 2114.

R. A. (1860), $16^h\ 55^m\ 18^s$.
Dec. N. 8° 39′.
Mags. $a = 7$, $b = 8$.
Colours: Smyth, 1832, both white; Morton, 1859, whi., bluish white.

Struve………	1830·97	135·40	1·34
Smyth………	1832·41	137·00	1·50
Dawes………	1847·63	143·38	…
Secchi………	1856·84	145·25	1·25
Morton ……	1859·30	147·38	1·31

HERCULIS 210. Σ 2120.

R. A. (1860), $16^h\ 59^m\ 6^s$.
Dec. N. 28° 17′.
Mags. $a = 6\frac{1}{2}$, $b = 9$.
Colours: Secchi, 1856, yellow, blue.

Struve………	1833·25	3·80	3·44
Mädler ……	1842·30	345·48	2·73
Dawes………	1848·55	322·72	2·31
Morton ……	1855·61	298·50	2·57
Secchi………	1856·75	290·45	2·48
Dembowski ..	1865·09	272·89	2·98
Talmage……	1866·44	272·94	3·56

μ Draconis. Σ 2130.

R. A. $17^h\ 2^m\ 33^s$.
Dec. N. $54^\circ\ 39'\ 7''$.
Mags. $a = 4$, $b = 4\frac{1}{2}$.
Colours: Smyth, 1839, both white; Main, 1862, both white.

	Epoch.	P.	D.
		°	"
Herschel......	1781·73	232·22	4·35
Struve.........	1832·22	205·06	3·23
Smyth.........	1839·53	200·30	3·30
,, ...	1854·58	190·70	3·00
Morton	1854·67	*8·22	2·92
Secchi	1857·50	188·37	2·74
Dawes.........	1859·73	185·47	2·83
Dembowski ..	1863·14	*2·42	2·63
Main	1862·41	...	2·84
Secchi.........	1865·59	181·84	2·79

Orbital period, about 600 years (Smyth).

* These measures should evidently be +180.

36 Ophiuchi.

R. A. $17^h\ 7^m\ 1^s$.
Dec. S. $26^\circ\ 23'\ 28''$.
Mags. $a = 4\frac{1}{2}$, $b = 6\frac{1}{2}$.
Colours: Smyth, 1842, ruddy, pale yellow; Webb, 1854, both golden yellow.

Mayer.........	1780·00	360·00	13·00
South	1825·17	228·28	5·20
Smyth.........	1835·33	221·40	5·00
Dawes.........	1841·59	219·26	4·78
Smyth.........	1842·46	216·60	4·90
,, ...	1857·39	213·80	4·60
Secchi.........	1857·55	211·30	4·29
Main	1862·43	212·47	4·22

δ Herculis. Σ 3127.

R. A. $17^h\ 9^m\ 29^s$.
Dec. N. $25^\circ\ 0'\ 3''$.
Mags. $a = 4$, $b = 8\frac{1}{2}$.
Colours: Smyth, 1839, greenish wh., grape red; Main, 1862, straw-coloured, reddish; Webb, 1865, pale yellow, lilac.

Herschel......	1779·61	162·28	33·75
Struve.........	1829·77	173·42	26·11
Smyth.........	1839·62	175·10	24·50
Secchi.........	1857·50	177·97	21·92
Main	1862·38	177·59	20·02
Dembowski ..	1863·14	179·39	20·50
Knott	1866·72	179·61	20·18

ρ Herculis. Σ 2161.

R. A. $17^h\ 19^m\ 2^s$.
Dec. N. $37^\circ\ 16'\ 23''$.
Mags. $a = 4$, $b = 5\frac{1}{2}$.
Colours: Smyth, 1839, bluish white, pale emerald; Main, 1862, both bluish white.

	Epoch.	P.	D.
		°	"
Herschel......	1779·66	300·21	2·97
Struve.........	1830·35	307·22	3·60
Smyth.........	1839·74	308·90	3·70
,, ...	1853·39	310·50	3·50
Dawes.........	1854·73	308·83	3·91
Morton	1855·65	309·45	3·84
Secchi.........	1856·60	309·71	3·83
Main	1862·37	309·50	3·61

Σ 2173 Ophiuchi.

R. A. (1860), $17^h\ 24^m\ 12^s$.
Dec. S. $0^\circ\ 58'$.
Mags. $a = 6$, $b = 6{\cdot}8$.
Colours: Secchi, 1858, yell., orange.

Struve.........	1830·84	323·80	0·62
,, ...	1836·71	single	...
Dawes.........	1848·45	158·45	1·11
Secchi.........	1858·56	325·92	0·84

μ^1 Herculis. Σ 2220.

R. A. (1860), $17^h\ 41^m\ 0^s$.
Dec. N. $28^\circ\ 48'$.
B : C.
Mags. (Knott), $b = 10{\cdot}5$, $c = 10{\cdot}7$.
Colours: Knott, bluish white.

Dawes.........	1858·77	59·91	2·02
,, ...	1864·43	77·59	1·81
Knott	1865·43	79·61	1·83
Dembowski ..	1865·44	81·98	1·20

τ Ophiuchi. Σ 2262.

R. A. $17^h\ 55^m\ 43^s$.
Dec. S. $8^\circ\ 10'\ 36''$.
Mags. $a = 5$, $b = 6$.
Colours: Smyth, 1842, pale white.

Herschel......	1783·37	331·60	oblong
Struve.........	1836·62	199·90	0·44
Smyth.........	1842·52	227·00	0·90
,, ...	1855·34	238·80	1·10
Dawes.........	1854·67	238·05	1·22
Dembowski ..	1863·05	244·57	1·40
Knott	1863·59	246·84	1·20
Secchi.........	1866·70	248·05	1·60

Orbital period about 130 years (Smyth).

70 Ophiuchi. Σ 2272.

R. A. $17^h\ 58^m\ 37^s$.
Dec. N. $2°\ 32'\ 30''$.
Mags. $a = 4\frac{1}{2}$, $b = 7$.

Colours: Smyth, 1842, pale topaz, violet; Webb, 1850, yell.-orange; Main, 1861, bright yell., reddish; Dembowski, 1863, yell., rose-col.

	Epoch.	P.	D.
		°	″
Herschel......	1779·77	90·00	3·59
„	1804·41	318·48	2·56
Struve.........	1819·63	168·42	4·66
South	1825·56	148·18	4·76
Smyth.........	1835·56	130·60	5·97
„	1842·55	122·40	6·64
„	1852·44	114·90	6·50
Dawes.........	1859·72	109·33	6·24
Main	1861·46	107·30	5·89
Dembowski ..	1863·06	104·96	5·66
Secchi.........	1863·51	104·07	5·28
„	1865·41	102·69	5·40
„	1866·60	101·13	5·27

Perihelion passage, 1806.

α Lyræ.

R. A. $18^h\ 32^m\ 20^s$.
Dec. N. $38°\ 39'\ 15''$.
Mags. $a = 1$, $b = 11$.

Colours: Smyth, 1843, p. sapphire, smalt-blue.

Herschel......	1792·32	116·14	42·99
South	1822·87	132·07	42·11
Dawes.........	1830·42	135·03	42·46
Smyth.........	1837·51	137·90	42·70
„	1843·34	140·30	43·40
Secchi.........	1857·55	148·70	45·50
Dembowski ..	1865·63	150·12	46·15

ϵ^1 Lyræ 4. Σ 2382.

R. A. $18^h\ 39^m\ 51^s$.
Dec. N. $39°\ 31'\ 43''$.
A : B.
Mags. $a = 5$, $b = 6\frac{1}{2}$.

Colours: Smyth, 1842, yell., ruddy; Webb, 1849, yellow, tawny.

Herschel......	1779·83	33·55	3·54
Struve.........	1831·44	26·06	3·03
Smyth.........	1842·59	20·60	3·20
„	1853·71	19·70	3·00
Secchi.........	1856·23	22·42	3·07
Dawes.........	1859·73	19·32	3·06
Main	1861·45	20·23	3·06
Dembowski ..	1863·09	19·35	3·04

ϵ^2 Lyræ 5. Σ 2383.

C : D.
Mags. $c = 5$, $d = 5\frac{1}{2}$.

Colours: Smyth, 1842, both white; Webb, 1849, both yellowish wh.; Main, 1861, both white.

	Epoch.	P.	D.
		°	″
Herschel......	1779·83	173·28	3·50
Struve.........	1831·44	155·10	2·57
Smyth.........	1842·59	150·90	2·60
„	1853·71	148·10	2·50
Secchi.........	1856·06	148·40	2·57
Main	1861·45	152·39	2·43
Dembowski ..	1863·09	143·97	2·47
Dawes.........	1865·75	144·86	2·56

Smyth (Spec. Hart. 1853) considered that the relationship between ε 4 and 5 Lyræ was not yet established, but that they have a common movement in space.

Σ 2402 Serpentis.

R. A. (1860), $18^h\ 43^m\ 0^s$.
Dec. N. $10°\ 32'$.
Mags. $a = 8$, $b = 8\frac{1}{2}$.

Colours: Secchi, 1856, both white.

Struve.........	1830·20	197·67	0·74
Mädler	1838·83	204·31	0·69
Secchi.........	1856·64	213·41	0·89

P. XVIII. 274 Antinoi. Σ 2434.

R. A. $18^h\ 55^m\ 48^s$.
Dec. S. $0°\ 53'\ 56''$.
A : B.
Mags. $a = 9{\cdot}2$, $b = 9$.

Colours: Smyth, 1838, both white.

Struve.........	1822·67	149·06	26·09
„	1831·57	147·02	25·56
Mädler	1835·53	145·78	25·45
Smyth.........	1838·59	146·80	25·60
Secchi.........	1856·93	138·87	24·48
Dembowski ..	1864·66	136·85	24·29

B : C. $c = 16$, blue.

Struve.........	1831·57	80·50	1·93
Smyth.........	1838·59	85·00	2·00
Secchi.........	1857·12	68·70	1·73
Dembowski ..	1864·66	69·60	2·79

Σ 2455 VULPECULÆ.

R. A. (1860), $19^h\ 0^m\ 54^s$.
Dec. N. 21° 58′.
Mags. a =7½, b =9½.
Colours: Secchi, 1857, both white.

	Epoch.	P.	D.
		°	″
Struve.........	1828·77	144·47	4·92
Mädler	1839·29	136·60	4·41
Morton	1855·66	124·20	3·98
Secchi.........	1857·29	123·01	3·70
Dembowski ..	1864·96	115·53	3·53

P. XIX. 108 DRACONIS. Σ 2509.

R. A. (1860), $19^h\ 15^m\ 30^s$.
Dec. N. 62° 57′.
Mags. a =6½, b =8.
Colours: Secchi, 1857, purple, green.

Struve.........	1832·30	353·00	0·52
Secchi	1857·42	340·28	0·68
Dembowski ..	1862·98	343·78	0·80

δ CYGNI. Σ 2579.

R. A. $19^h\ 40^m\ 45^s$.
Dec. N. 44° 48′ 8″.
Mags. a =3½, b =9.
Colours: Smyth, 1842, pale yellow, sea-green; Secchi, 1856, yellow, violet; Dembowski, 1865, white, blue.

Herschel......	1783·72	71·39	2·50
Struve.........	1826·55	40·39	1·91
Smyth.........	1837·78	30·90	1·50
„	1842·56	25·60	1·80
„	1852·69	14·70	1·50
Dembowski ..	1865·02	350·76	1·57
Dawes.........	1865·38	349·62	1·67
Secchi.........	1865·54	348·45	1·46
Knott	1866·68	348·31	1·70

Perihelion passage, 1860.

O Σ 400 CYGNI.

R. A. $20^h\ 5^m\ 30^s$.
Dec. N. 43° 33′ 42″.
Mags. a =7½, b =8½.
Colours:

Struve, O. ...	1844·83	336·90	0·65
Dawes.........	1853·89	320·55	0·65
Struve, O. ...	1861·62	316·70	0·62

Σ 2696 DELPHINI.

R. A. (1860), $20^h\ 26^m\ 36^s$.
Dec. N. 4° 58′.
Mags. a =8, b =8½.
Colours: Secchi, 1856, both white.

	Epoch.	P.	D.
		°	″
Struve.........	1831·06	298·92	1·06
Mädler	1838·27	302·80	0·99
Secchi	1856·61	310·26	0·72

λ CYGNI. O Σ 413.

R. A. (1860), $20^h\ 41^m\ 54^s$.
Dec. N. 35° 55′.
Mags. a =6, b =7.
Colours: both white.

Struve, O. ...	1842·66	122·35	0·65
Secchi.........	1859·61	101·48	0·65
Dawes.........	1860·81	96·51	0·72
„	1866·99	92·51	0·69

4 AQUARII. Σ 2729.

R. A. $20^h\ 44^m\ 16^s$.
Dec. S. 6° 7′ 45″.
Mags. a =6, b =8.
Colours: Smyth, 1834, pale yellow, purple; Secchi, 1856, both yellow.

Herschel......	1782·68	351·30	0·30
Struve.........	1825·59	25·00	0·81
Smyth.........	1834·69	45·00	0·50
Dawes.........	1854·75	101·70	0·3±
Secchi.........	1856·81	107·86	0·30

ε EQUULEI. Σ 2737.

R. A. $20^h\ 52^m\ 20^s$.
Dec. N. 3° 46′ 46″.
A : B.
Mags. a =5½, b =7½.
Colours: Smyth, 1838, white, lilac; Dembowski, 1862, both white.

Smyth.........	1838·83	290·00	0·50
Secchi	1855·87	287·44	0·81
Dawes.........	1861·57	285·43	0·96
Dembowski ..	1862·64	283·87	0·60
Knott	1863·66	287·11	1·01
„	1865·68	288·08	1·07
Secchi.........	1866·70	290·25	1·06

[*Continued.*

ε Equulei (*continued*).

A : C. $c = 7\frac{1}{2}$, blue.

	Epoch.	P.	D.
		°	″
Herschel......	1780·59	84·21	9·37
South	1823·58	79·21	12·37
Smyth.........	1833·77	77·60	10·70
„	1838·83	78·10	11·20
Secchi.........	1855·87	73·93	10·55
Dembowski ..	1862·64	76·17	10·83
Secchi.........	1866·70	73·13	10·55

61 Cygni. Σ 2758.

R. A. $21^h\ 0^m\ 41^s$.
Dec. N. 38° 3′ 54″.
Mags. $a = 5\frac{1}{2}$, $b = 6$.
Colours: Smyth, 1839, both yellow; Webb, 1850, both deep yellow; Main, 1861, both yellow.

Bradley	1753·80	35·24	19·63
Mayer.........	1778·00	50·58	15·24
Herschel......	1780·72	53·32	16·08
Piazzi	1800·00	69·18	18·20
Bessel	1812·30	79·07	16·74
Struve.........	1819·90	83·02	15·20
South	1822·90	84·41	15·43
Dawes.........	1830·66	90·20	15·70
Smyth.........	1839·69	96·30	16·30
„	1848·07	99·80	16·40
„	1853·80	103·70	17·00
Secchi	1855·99	105·93	17·94
Main	1861·85	107·42	17·89
Dembowski ..	1865·15	110·64	18·55
Knott	1866·72	111·69	18·76

Orbital period, about 540 years (Smyth).

A. Z. XXIV. 11. A. C. 19.

R. A. (1860), $21^h\ 10^m\ 50^s$.
Dec. N. 63° 49′ 48″.
Mags. $a = 7\frac{1}{2}$, $b = 7\frac{1}{2}$.
Colours: both pale yellow.

Struve, O. ...	1843 ±	Single.	
Dawes.........	1860·12	246·25	0·89
„	1866·83	244·53	0·98

20 Pegasi. Σ 2799.

R. A. (1860), $21^h\ 22^m\ 24^s$.
Dec. N. 10° 28′.
Mags. $a = 6\frac{1}{2}$, $b = 7\frac{1}{2}$.
Colours: Secchi, 1856, pale yellow.

	Epoch.	P.	D.
		°	″
Struve.........	1831·82	332·88	1·35
Mädler	1835·81	332·90	1·39
Dawes.........	1854·74	320·31	1·18
Secchi.........	1856·27	320·70	1·23
Dembowski ..	1863·09	317·57	1·44

P. XXII. 33 Pegasi. Σ 2877.

R. A. (1860) $22^h\ 7^m\ 42^s$.
Dec. N. 16° 30′.
Mags. $a = 6\frac{1}{2}$, $b = 9\frac{1}{2}$.
Colours: Secchi, 1857, yellow, blue.

Struve.........	1828·95	316·45	7·63
Mädler	1836·57	322·40	7·83
Secchi.........	1857·35	337·45	8·56
Dembowski ..	1863·67	342·20	8·99

ζ Aquarii. Σ 2909.

R. A. $22^h\ 21^m\ 53^s$.
Dec. S. 0° 42′ 37″.
Mags. $a = 4$, $b = 4\frac{1}{2}$.
Colours: Smyth, 1842, very white, white: Webb, 1851, both p. yell.

Herschel......	1779·70	18·21	4·56
Piazzi	1800·00	0·00	3· ±
Struve.........	1820·92	358·18	4·40
Smyth.........	1831·83	356·00	3·60
„	1842·59	348·90	2·70
„	1852·81	346·90	3·20
Main	1861·78	340·43	3·28
Dembowski ..	1863·14	339·04	3·52
Secchi.........	1866·70	347·83	3·38
Knott	1866·71	337·01	3·64
Dawes.........	1866·99	336·33	3·32

Orbital period, about 750 years (Smyth).

37 Pegasi. Σ 2912.

R. A. $22^h\ 23^m\ 9^s$.
Dec. N. 3° 44′ 54″.
Mags. $a = 6$, $b = 7\frac{1}{2}$.
Colours: Smyth, 1839, both white; Secchi, 1857, both white.

Struve.........	1831·12	112·63	1·16
Smyth.........	1839·60	118·90	1·10
Dawes.........	1854·54	118·53	0·91
Secchi.........	1857·09	117·56	0·74

Orbital period, about 500 years (Smyth).

Σ 2934 Pegasi.

R. A. (1860) 22^h 35^m 6^s.
Dec. N. 20° 42′.
Mags. a = 7½, b = 9.
Colours: Secchi, 1856, both white.

	Epoch.	P.	D.
		°	″
Struve.........	1830·07	187·83	1·22
Mädler	1838·19	182·21	1·20
Secchi.........	1856·86	168·23	1·10
Dembowski ..	1863·82	164·70	1·21

π Cephei.

R. A. 23^h 3^m 36^s.
Dec. N. 74° 39′ 29″.
A : a.
Mags. A = 5, a = 10.
Colours: Smyth, 1843, deep yellow, purple.

Smyth.........	1843·77	330·00	1·80
Knott	1865·71	5·97	1·15

o Cephei. **Σ 3001.**

R. A. (1860), 23^h 12^m 54^s.
Dec. N. 67° 21′.
Mags. a = 6, b = 8½.
Colours: Secchi, 1858, yellow, blue.

Struve.........	1832·84	174·97	2·35
Mädler	1839·55	178·19	2·39
Secchi.........	1858·43	187·15	2·47
Morton	1858·61	186·51	2·60
Powell	1861·01	184·00	...
Main	1862·57	182·16	2·28

P. XXIII. 69 Aquarii. **Σ 3008.**

R. A. 23^h 16^m 47^s.
Dec. S. 9° 12′ 0″.
Mags. a = 8, b = 8½.
Colours: Smyth, 1834, both flushed; Secchi, 1856, yellow, blue.

	Epoch.	P.	D.
		°	″
South	1824·80	274·04	7·98
Struve.........	1830·89	273·33	7·54
Smyth.........	1834·79	272·10	7·50
Mädler	1837·54	271·16	7·11
Secchi.........	1856·86	265·57	6·11
Morton	1859·91	263·57	5·58
Dembowski ..	1863·08	262·88	5·59

Σ 3062 Cassiopeæ.

R. A. (1860), 23^h 58^m 54^s.
Dec. N. 57° 39′.
Mags. a = 6½, b = 7·3.
Colours: Secchi, 1857, yell., orange.

Herschel......	1782·65	320·70	...
Mädler	1825·81	36·70	1·25
Struve.........	1833·71	108·57	0·55
Morton	1856·90	247·57	1·32
Secchi.........	1857·60	253·39	1·25
Dawes.........	1863·86	265·61	1·40
Dembowski ..	1865·18	269·84	1·37
Knott	1865·71	269·95	1·43
Talmage......	1865·98	271·38	1·23

Perihelion passage, 1837.

APPENDIX.

The discrepancies found in the measures of the following objects render it doubtful whether they should be classed with the binaries, although in many instances the difference in the angles of position amounts to several degrees; but, owing either to the closeness of the stars or their minuteness, it is difficult to measure them.

Since the date of Struve's Catalogue, all the objects in the following List have been measured by Father Secchi and the Baron Dembowski, and some of them by Mr. Dawes and other observers: but for comparison the epochs of Struve and Dembowski are considered sufficient.

The right ascensions, declinations, and magnitudes are given for the year 1860 from Secchi's Catalogue.

Σ 44 ANDROMEDÆ.

R. A. $0^h\ 30^m\ 36^s$.
Dec. N. 40° 13′.
Mags. a =8½, b =9·3.

	Epoch.	P.	D.
		°	″
Struve.........	1829·82	258·83	7·86
Dembowski ..	1865·09	263·20	8·66

Σ 208, 10 ARIETIS.

R. A. $1^h\ 55^m\ 42^s$.
Dec. N. 25° 16′.
Mags. a =6, b =8½.

Struve.........	1833·05	25·17	1·98
Dembowski ..	1863·07	33·92	1·43

Σ 234 CASSIOPEÆ.

R. A. $2^h\ 7^m\ 6^s$.
Dec. N. 60° 42′.
Mags. a =8, b =8·7.

Struve.........	1831·55	239·23	0·83
Dembowski ..	1863·45	231·43	0·70

Σ 295, 84 CETI.

R. A. $2^h\ 34^m\ 6^s$.
Dec. S. 1° 17′.
Mags. a =6, b =10.

Struve.........	1831·90	334·62	4·85
Dembowski ..	1863·97	324·73	4·63

Σ 367 CETI.

R. A. $3^h\ 6^m\ 48^s$.
Dec. N. 0° 12′.
Mags. a =8, b =8.

Struve.........	1831·72	281·40	0·95
Dembowski ..	1864·01	257·10	0·50

O Σ 97 TAURI.

R. A. $4^h\ 58^m\ 5^s$.
Dec. N. 22° 53′ 6″.
Mags. a =6½, b =7½.

	Epoch.	P.	D.
		°	″
Struve, O. ...	1849	Separated	
Dawes.........	1866	Single	

Σ 728, 32 ORIONIS.

R. A. $5^h\ 23^m\ 18^s$.
Dec. N. 5° 50″.
Mags. a =5·2, b =6½.

Struve.........	1833·96	207·75	1·04
Smyth.........	1839·20	206·20	1·00
Dembowski ..	1863·33	192·24	...

Σ 749 TAURI.

R. A. $5^h\ 28^m\ 30^s$.
Dec. N. 26° 50′.
Mags. a =6½, b =6·6.

Struve.........	1829·48	203·45	0·67
Dembowski ..	1862·98	186·44	0·60

Σ 963, 14 LYNCIS.

R. A. $6^h\ 40^m\ 42^s$.
Dec. N. 59° 40′.
Mags. a =6, b =6.

Struve.........	1830·88	51·51	0·89
Dembowski ..	1863·44	59·53	0·70

Σ 997, μ CANIS MAJORIS.

R. A. $6^h\ 49^m\ 0^s$.
Dec. S. 13° 48′.
Mags. a =5, b =8½.

Struve.........	1831·20	343·53	3·22
Dembowski ..	1864·09	337·20	2·76

Σ 1216 Hydræ.

R. A. $8^h\ 14^m\ 12^s$.
Dec. S. $1°\ 9'$.
Mags. $a = 7$, $b = 7\frac{1}{2}$.

	Epoch.	P.	D.
		°	″
Struve.........	1831·24	115·17	0·45
Dembowski ..	1863·35	151·13	...

Σ 1306, σ^2 Ursæ Majoris.

R. A. $8^h\ 58^m\ 0^s$.
Dec. N. $67°\ 41'$.
Mags. $a = 6·3$, $b = 9\frac{1}{2}$.

Struve.........	1832·14	263·55	4·58
Dembowski ..	1863·19	253·51	3·25

Σ 1316 Hydræ. (A : B.)

R. A. $9^h\ 0^m\ 54^s$.
Dec. S. $6°\ 34'$.
Mags. $a = 7$, $b = 11\frac{1}{2}$.

Struve.........	1832·88	146·33	6·78
Dembowski ..	1864·84	138·40	6·74

Σ 1348, 110 Hydræ.

R. A. $9^h\ 17^m\ 6^s$.
Dec. N. $6°\ 57'$.
Mags. $a = 7\frac{1}{2}$, $b = 7\frac{1}{2}$.

Struve.........	1831·02	334·30	1·09
Dembowski ..	1863·15	328·15	1·66

Σ 1357 Hydræ.

R. A. $9^h\ 21^m\ 30^s$.
Dec. S. $9°\ 23'$.
Mags. $a = 7$, b $10\frac{1}{2}$.

Struve.........	1831·20	51·40	7·54
Secchi.........	1856·27	59·58	7·60

Σ 1781 Virginis.

R. A. $13^h\ 39^m\ 6^s$.
Dec. N. $5°\ 49'$.
Mags. $a = 7$, $b = 7·8$.

Struve.........	1856·39	246·56	0·99
Dembowski ..	1864·75	251·77	1·10

Σ 1788, P. XIII. 238 Virginis.

R. A. $13^h\ 47^m\ 42^s$.
Dec. S. $7°\ 22'$.
Mags. $a = 6\frac{1}{2}$, $b = 7·3$.

	Epoch.	P.	D.
		°	″
Struve.........	1831·38	54·04	2·36
Dembowski ..	1864·85	67·70	2·36

Σ 1825, 121 Bootis.

R. A. $14^h\ 10^m\ 6^s$.
Dec. N. $20°\ 47'$.
Mags. $a = 7$, $b = 8$.

Struve.........	1830·66	185·70	3·44
Dembowski ..	1864·47	178·80	3·89

Σ 1837, P. XIV. 70.

R. A. $14^h\ 17^m\ 6^s$.
Dec. S. $11°\ 18'$.
Mags. $a = 7$, $b = 8·6$.

Struve.........	1829·83	326·87	1·49
Dembowski ..	1865·07	314·15	1·34

Σ 1863 Bootis.

R. A. $14^h\ 33^m\ 18^s$.
Dec. N. $52°\ 10'$.
Mags. $a = 7$, $b = 7·2$.

Struve.........	1830·14	109·75	0·65
Dembowski ..	1864·37	95·23	...

Σ 1865, ζ Bootis.

R. A. $14^h\ 34^m\ 30^s$.
Dec. N. $14°\ 20'$.
Mags. $a = 4\frac{1}{2}$, $b = 5$.

Struve.........	1830·47	309·17	1·18
Dembowski ..	1864·78	303·25	1·02

Σ 1883 Bootis.

R. A. $14^h\ 41^m\ 54^s$.
Dec. N. $6°\ 33'$.
Mags. $a = 7$, $b = 7·4$.

Struve.........	1830·37	271·96	1·23
Dembowski ..	1863·28	262·70	0·80

Σ 1934 Bootis.

R. A. $15^h\ 12^m\ 24^s$.
Dec. N. 44° 18″.
Mags. a = 8·2, b = 8½.

	Epoch.	P.	D.
		°	″
Struve.........	1830·88	45·13	5·29
Dembowski ..	1864·88	38·10	6·05

Σ 1957 Serpentis.

R. A. $15^h\ 29^m\ 18^s$.
Dec. N. 13° 23′.
Mags. a = 8, b = 9.

Struve.........	1831·10	163·12	1·41
Dembowski ..	1863·51	155·70	1·53

Σ 2165, Herculis 281.

R. A. $17^h\ 20^m\ 48^s$.
Dec. N. 29° 35′
Mags. a = 7½, b = 8½.

Struve.........	1832·16	45·72	6·71
Dembowski ..	1864·57	51·17	7·10

Σ 2199 Draconis.

R. A. $17^h\ 36^m\ 0^s$.
Dec. N. 55° 50′.
Mags. a = 7, b = 7½.

Struve.........	1830·94	116·37	1·66
Dembowski ..	1863·06	101·45	1·65

Σ 2289, Herculis 417.

R. A. $18^h\ 3^m\ 54^s$.
Dec. N. 16° 27′.
Mags. a = 6½, b = 7½.

Struve.........	1829·96	243·12	1·20
Dembowski ..	1862·95	234·33	1·24

Σ 2437 Sagittæ.

R. A. $18^h\ 55^m\ 48^s$.
Dec. N. 18° 58′.
Mags. a = 7½, b = 7·8.

Struve.........	1839·79	80·84	1·08
Dembowski ..	1863·06	71·47	0·80

Σ 2454 Lyræ.

R. A. $18^h\ 59^m\ 24^s$.
Dec. N. 30° 11′.
Mags. a = 8, b = 9.

	Epoch.	P.	D.
		°	″
Struve.........	1831·50	203·97	0·75
Dembowski ..	1865·32	225·97	1·26

Σ 2525, Cygni 22.

R. A. $19^h\ 21^m\ 6^s$.
Dec. N. 27° 2′.
Mags. a = 7, b = 7½.

Struve.........	1830·43	255·90	1·33
Dembowski ..	1865·22	240·84	0·60

Σ 2544 Aquilæ. (A:B.)

R. A. $19^h\ 30^m\ 24^s$.
Dec. N. 8° 0′.
Mags. a = 7·2, b = 9½.

Struve.........	1828·99	218·40	1·14
Dembowski ..	1864·21	208·90	1·20

Σ 2556 Vulpeculæ.

R. A. $19^h\ 33^m\ 24^s$.
Dec. N. 21° 55′.
Mags. a = 7, b = 7.

Struve.........	1829·83	188·40	0·56
Dembowski ..	1864·91	167·72	...

Σ 2576 Cygni.

R. A. $19^h\ 40^m\ 18^s$.
Dec. N. 33° 17′.
Mags. a = 7·6, b = 7·8.

Struve.........	1831·80	318·80	3·59
Dembowski ..	1863·35	308·85	3·27

Σ 2744 Aquarii.

R. A. $20^h\ 55^m\ 54^s$.
Dec. N. 0° 59′.
Mags. a = 6·3, b = 7·1.

Struve.........	1830·16	190·54	1·52
Dembowski ..	1863·24	177·55	1·50

Σ 2746 Cygni.

R. A. $20^h\ 55^m\ 0^s$.
Dec. N. 38° 31′.
Mag. a = 8, b = 8·7.

	Epoch.	P.	D.
		°	″
Struve.........	1830·82	276·25	0·87
Dembowski ..	1863·33	283·70	0·80

Σ 2804, Pegasi 29.

R. A. $21^h\ 26^m\ 30^s$.
Dec. N. 20° 6′.
Mags. a = 7·1, b = 8.

Struve.........	1831·62	316·90	2·90
Dembowski ..	1864·87	324·52	2·75

Σ 2928 Aquarii.

R. A. $22^h\ 32^m\ 6^s$.
Dec. S. 13° 20′.
Mags. a = 8, b = 8·3.

Struve.........	1830·82	327·70	4·69
Dembowski ..	1863·11	319·35	4·38

Σ 2944, P. XXII. 219. (A : C.)

R. A. $22^h\ 40^m\ 36^s$.
Dec. S. 4° 57′.
Mags. a = 7, c = 8.

Struve.........	1833·01	157·32	55·64
Dembowski ..	1862·68	146·67	50·67

Σ 2976 Piscium. (B : C.)

R. A. $23^h\ 0^m\ 36^s$.
Dec. N. 5° 51′.
Mags. b = 9½, c = 9·9.

	Epoch.	P.	D.
		°	″
Struve.........	1828·43	177·68	15·88
Secchi.........	1857·41	183·23	16·31

Σ 3046 Ceti.

R. A. $23^h\ 49^m\ 30^s$.
Dec. S. 10° 16′.
Mags. a = 8, b = 8·3.

Struve.........	1830·15	232·20	2·51
Dembowski ..	1863·92	241·05	2·90

Σ 3050, Andromedæ 37.

R. A. $23^h\ 52^m\ 18^s$.
Dec. N. 32° 57′.
Mags. a = 5·7, b = 6·3.

Struve.........	1832·65	191·03	3·78
Dembowski ..	1864·84	199·52	3·17

Σ 3107, Ophiuchi.

R. A. $16^h\ 51^m\ 6^s$.
Dec. N. 4° 8′.
Mags. a = 8, b = 8½.

Struve.........	1831.83	112·30	1·59
Dembowski ..	1864·53	104·37	1·32

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ROYAL ASTRONOMICAL SOCIETY.

Sixth Meeting, April 12, 1867.

The Rev. C. Pritchard, M.A., F.R.S., *President*, in the Chair.

Secretaries—Mr. Stone and Mr. Huggins.

The minutes of the last meeting were read and confirmed.

Thirty-two presents were announced, and the thanks of the Society given to the respective donors. The most important works were vol. ii. of Delaunay's Theory of the Movement of the Moon; a Treatise on Astronomy and Geodesy, by M. Lias; and vol. iii. of the reprint of the Astronomical Works of Alphonso X., King of Castile, from the Madrid Academy.

Frederick Varley, Esq. Balfour Stewart, Esq., F.R.S.
Sir And. Scott Waugh, F.R.S. Stephen N. Yeates, Esq., and
William Ladd, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were read, or had the titles announced:—

Catalogue of Micrometrical Measurements of Double Stars: by the Rev. W. R. Dawes.

The highly interesting and valuable introduction to this Catalogue was read; but, from its great length, we can only now give an abstract of it. The measurements include all made since the close of the author's second series (Mem. *R. A. S.*, vol. xix.) and the present time. The principal part of the series contains the observations made to the end of 1854, with an Appendix containing such subsequent measures as have been effected; and the Catalogue is preceded by a description of the micrometers employed. The weights attached to each observation have been carefully taken into account in the mean results. In the notes are collected, for comparison, the results obtained by other observers, including the late Prof. Struve, Prof. Mädler of Dorpat, Prof. Secchi, Prof. Otto Struve, Prof. Kaiser of Leyden, and the Baron Dembowski.

The micrometers used were—1, the repeating or parallel wire micrometer employed at Mr. Bishop's Observatory, South Villa, Regent's Park. For angles of position, the stars are placed between two thick parallel wires, instead of being bisected by one spider line. A Barlow lens was also frequently used with this instrument. 2, the prismatic crystal micrometer employed at the South Villa Observatory. It is essential to accuracy that the object should be pretty near the middle of the field, and a little light was sometimes admitted to ensure this. Mr. Dawes formed the opinion that, on the whole, the angles of position measured by placing the four stars in a line are not quite worthy of the same confidence as those procured by placing the image between the thick parallel wires of the repeating micrometer. The distances, on the contrary, are as accurately measured as the observer's eye and the state of the atmosphere will allow; and distances may be tolerably estimated when the stars could not, from the disturbed condition of the air, be kept on the webs of a wire micrometer. The perfect action of the driving clock is also of less importance with this instrument. 3, Merz's parallel wire micrometer. This instrument could have the wires illuminated in a dark field, but Mr. Dawes soon found the measures so made could not be depended on for accuracy in distance. The spider lines also were too thick for very close double stars; but this was entirely remedied by using a Barlow lens. 4, the spherical crystal micrometer. The measures of position made with this instrument are not considered equal in precision to those obtained by the parallel wire micrometer, and the value of the scale for distance is not uniform; but Mr. Dawes ultimately ascertained the law of the variation. 5, Amici's double-image micrometer. This was made for Sir J. Herschel's 20-ft. reflector, and was found very efficient on many objects; with the full aperture, it produces a spectrum of each star, but the disks can be rendered beautifully round by employing a double circular, or figure of 8 aperture (Monthly Notices, vol. xviii. No. 3). A combination of the parallel wire micrometer instead of the ordinary eye-piece of the Amici is also recommended. 6, the 4-glass double-image micrometer. This instrument is fully described, with some of the author's adaptations.

The author then adverts to several points which the experience of 35 years has convinced him are of great importance, and first—in *position*. 1. The star should be brought nearly to touch one of the wires on each side of it alternately, by which a tendency to place one of the double wires nearly in the direction of a tangent to the disks may be detected. 2. The wires having been brought nearly to the right direction, attempts will be made to improve this, and the eye will have a tendency to accommodate its judgment to the position of the wire. The eye should therefore be removed from the telescope between each alteration, so as to remove any previous impression, and come fresh to its work. 3. In measuring the distance of close double stars, it is useful to place a single web as centrally as possible on each, and note the change made in the form of its disk. The effect is to swell out the disk on each side of the web, and thus fill up the gap between the pair. This must be carefully noted and eliminated. Such an effect probably caused the excess in the early measures of many excellent observers.

Mr. Dawes then makes copious remarks on the use of various telescopic apertures:—1. Sir J. Herschel has recommended a round disk placed centrally before the object-glass, which increases the separating power of the telescope, but also the number and brightness of the rings. They are also thrown further from the disks, and small companions are often hidden by them, and disks of equal stars elongated by the rings passing through them, so that it has been seldom used. 2. A perforated card covering the whole aperture is sometimes advantageous, and the cardboard perforated for Berlin-wool work answers well for this purpose. At some distance from the star are arranged highly-coloured prismatic spectra. The effect on Venus is very fine. Rows of holes in concentric circles are also sometimes employed; 15 such circles, containing 770 holes, give an exposed area of about 5 inches instead of 8¼ on Mr. Dawes' telescope, the former plan of perforations all over reducing it to about 2 inches. The disks are smaller with the circles, and the brightness of the rings diminished. 3. A different and sometimes more useful effect is produced by angular apertures. A triangle destroys the rings round bright stars, but renders the disks hexagonal, with six bright rays from the extremities. An inscribed hexagon is still more useful, rendering the rays feebler, and working well on moderately bright stars. 4. The disks of stars sometimes become triangular, especially with an east wind, to which an antidote may be found in cutting off three equidistant segments from the whole aperture. The association of this form of disk with the east wind is exceedingly curious and unaccountable, but quite certain, and Mr. Dawes narrates some crucial instances of the fact. 5. Sometimes a smaller aperture will show a delicate and close comes to a bright star when a large aperture will not. In such a case, the bright ring passes outside the small star with the small aperture, but through it with the large one, quite obscuring it. Mr. Dawes had a striking example of this with a 5-ft. refractor of 3·8 inches aperture, which separated ζ Herculis, then having a distance of 1″·25, when an equally good telescope of 5 inches aperture failed to do it. In the latter case, the bright ring passed through the small star, and made it look only like a brighter part of the ring. 6. A slight change in the adjustment of the object-glass, with respect to the axis of the tube, will sometimes increase the visibility of an object. 7. The separating power of any given telescopic aperture is a point of great importance; and Mr. Dawes, having found that the diameters of star disks vary inversely as the aperture, took one inch as a standard, and ascertained that with this he could separate stars of the sixth magnitude 4″·6 apart. With this constant he has constructed a table, of which we give the following examples:—

Aperture	Central distance separated	Aperture	Central distance separated
Inches	″	Inches	″
1	4·36	6	0·76
1·6	2·85	8	0·57
2	2·28	10	0·45
3	1·52	15	0·30
4	1·14	25	0·18
5	0·91	30	0·15

The brightness of the stars makes very little difference in this respect, as the diameter of the disk does not increase in the same proportion as the power. 8. A moderate degree of uncorrected spherical aberration does not make a great difference, as generally supposed, in the diameter of stars' disks, neither are they affected by the proportion of focal length to aperture; and Mr. Dawes exemplifies this by an account of the performance of two telescopes strongly contrasted in this respect. Tests of separation of double stars are not, therefore, tests of excellence of figure. 9. In measuring planetary diameters, an effect of diffraction producing light beyond the wires must be guarded against. 10. Stars at small altitudes require a shorter focus than when high. The difference is slight, but decided and constant, and independent of the brightness of the object. 11. Great fatigue to the eye will be avoided by not commencing to observe with the focus too short, but letting it be always too long at first, and then adjusting it to the right point. It is probable that the projection of stars on the dark limb of the Moon is sometimes due to the action on the eye of a short focus.

The President: As far as I can remember, I do not think any paper ever presented to the Society has had more points of practical importance. It embodies the results of 35 years of honest labour of an observer with a superior eye, directing his energies not only to an examination of the heavens, but of all kinds of telescopes and eye-pieces. It is a paper to be read and considered, and it would be premature to discuss it to-night. I therefore propose, at the next meeting, after it shall have been printed and in the hands of the Fellows, to refer to it again, and ask any gentleman I think qualified for his remarks on it. No doubt there will be some differences of opinion. I expect Mr. Browning obtains different results with his beautiful reflectors; and I will take the liberty of calling upon him at the next meeting for his views on the subject, to which time we will postpone the discussion of the paper.

Mr. Vignolles: Always supposing we get it some days before.

The President: The next communication will not be a paper, but an oral one. You will remember that when discussing the November meteors, and Mr. Adams gave us some information as to their orbit, I asked him to combine all the observations, and let us know the result. Professor Adams has done this; but, as there are other claims on him besides those of this Society, the paper has gone elsewhere, but he will kindly repeat the substance of it to us.

On the Orbit of the November Meteors: by Professor Adams.

A few years ago, Mr. Newton, of the United States, wrote two papers on this subject, and collected all the accounts of the detail of the appearances of these meteors from A.D. 902 to the present time. He found there was no regular interval between the successive appearances; but, taking the whole series, it accommodated itself very well to a period of 33¼ years for the recurrence. Sometimes they appear in two or three years consecutively, as in 1832, 1833, and 1834. The date also constantly gets later—nearly a day in each 35 years. There is evidently a drifting along at that rate. This is partly due to precession, but not half the motion can be due to that cause. We must admit that the Earth has really advanced further in its orbit each recurrence. The motion is about 29′ of longitude, which being established, becomes a very important fact. Mr. Newton made out that we are driven to a choice of five periods for the revolution of the meteors in their orbit round the Sun. 1. The natural idea is a period of 33¼ years; but then we must suppose that the meteors are not concentrated in any one part of the orbit, or we could not see them two or three years in succession. 2. Mr. Newton was more inclined to another hypothesis, according to which the period was a little less than one year—in fact, 11 days, or the 33rd part of a year, less; and then, if the string of meteors were long enough, we might still pass through them when carried round again more than once, after which we should not meet again for 32 or 34 years. He mentions some other possible but not probable periods, and throws out the important suggestion that the true orbit may perhaps be determined by the motion of the node or point of intersection of the orbits of the meteors and the Earth. This point must be subject to be acted on by the planets. After the last appearance, Professor Adams, having got a fair determination of the radiant point, and using Mr. Newton's smaller period, calculated the effect of Jupiter and Venus on the orbit or node, and then that of the Earth, these being the only planets likely to cause perturbations of the meteors. He found the aggregate effect of these three bodies only 21″ in a year, or 11′ in the 33 years out of the 29′ required—a result utterly inadequate to produce the observed motion. The other small possible periods were equally wrong; and he was therefore driven to adopt the theory of motion in an elongated elliptical orbit, there being no other alternative. He now calculated the effect of Jupiter, Saturn, and Uranus on such an orbit, as these large planets will be near it, extending as it does just beyond Uranus. Such a calculation is a much more complicated business than with a nearly circular orbit; but, fortunately, Gauss has given us a beautiful process applicable to the operation, the principle of which was explained by Professor Adams. To investigate the long ellipse, it is broken up into small parts, and the effect of the planets found on each, and the change produced in the node while the meteors move from point to point. The calculations are enormously long, notwithstanding some modifications in the process introduced by Professor Adams; and it must be remembered that the orbits do not lie all in the same plane. The result is, that in 33 years Jupiter produces a change of node of 20′, Saturn 7′, and Uranus a little more than 1′, making an aggregate effect of over 28′, the observed motion being 29′. This was a very near approximation indeed, and satisfied Professor Adams that beyond dispute the meteors have a period of 33¼ years, and an elliptical orbit. The period being the only uncertain element, and the radiant point and period being now found, all the elements of the orbit can be calculated. The mean of the published radiant points gives 143° 22′ longitude, and 9° 51′ latitude; and from these Professor Adams deduced the elements of the orbit which he exhibited. He also desired to call attention to the curious corroboration of his result arrived at on totally different grounds by another astronomer. This was Schiaparelli, of Milan, who, speculating on these bodies and where they came from, arrived at the conclusion that their orbits were like comets, and that they were allied to them in nature; and he showed that the orbits of the August meteors and the Comet II. of 1862 agreed. He tried also to find a comet with orbit similar to the November meteors, but, having an incorrect radiant point, failed. Le Verrier, with the 33¼ years' period, and a better determination of the radiant point, and likewise some German astronomers, have found a remarkable resemblance of the path of the November meteors to Tempel's Comet I. 1866. Professor Adams exhibited the two sets of elements side by side, and observed that they corresponded wonderfully, and confirmed the results of Schiaparelli's speculations greatly. His (Professor A.'s) investigations were undertaken without any reference to such a theory, but the change of node in each corresponds exactly.

The President: I think it will be admitted by all that two more interesting communications than this and the last have rarely been made on the same evening.

Mr. Stone: Does Le Verrier believe in the actual identity of the comet and the meteors?

Prof. Adams: I believe he does. The comet is an aggregation of meteors seen under different circumstances, and the string may last 2 or 3 years.

The President: I remember remarking that, with such a mass as came through our atmosphere, some of them ought to be seen at a distance.

Mr. Stone: I want Prof. Adams's opinion expressly whether on this theory any explanation can be given why the tails of comets are always turned from the sun?

The President: Tempel's comet had no tail.

Prof. Adams: I really cannot say; this particular comet had none.

The President: It strikes me such a mass of meteors must be visible at a distance, and may put on the appearance of a comet. Mr. Huggins saw this comet in the spectroscope, and drew certain conclusions, and this would go far to settle the question.

Mr. Huggins: Tempel's was a small comet, having a coma and nucleus. Prismatic analysis showed that the coma consisted of light like the Sun's; that it was solar light reflected to us; but there was a nearly central bright spot in the comet which was monochromatic, and presented one bright line at least. This was evidence that the comet had two distinct parts. The coma might be a swarm of meteorites reflecting sunlight. I should like to ask Prof. Adams what appearance the supposed long string of meteors would present?

Prof. Adams: Perhaps "long string" is hardly a good expression; a succession of groups is better—such groups being very numerous, and taking a long time to travel past.

The President: The Greenwich maxima and minima show that the shape of the meteoric ring was not symmetrical.

Mr. Huggins: Tempel's comet was circular—in fact, presented the normal appearance of a comet approaching the sun.

Mr. Brayley: One result may follow from combining Mr. Huggins's observations and the theory we have heard—viz. that the bright point may be the part which, passing through our atmosphere, produces the shower of meteors. Mr. Alexander Herschel points out the analogy of great levity between meteors and comets; and if the meteors be gaseous, it will account for their disappearance. The terms meteors and meteorites are often used indiscriminately, which is incorrect; meteorites being those bodies which fall to the earth only.

The President: It appears to me difficult to understand why, if the swarm of meteors be the comet, the brilliant nucleus was not seen as well as the bodies constituting the coma?

Prof. Adams: Probably this would not be seen anywhere.

The President: Why not? It could not have been more than 36°—a tenth part of the circumference—distant.

Prof. Adams: We should not necessarily see the nucleus.

The President: But if any part were seen, the other and bright part should be within 36°.

Prof. Adams: Tempel's comet may have been the nucleus, only a year and a half in advance.

Mr. Stone: If the coma constitute the meteoric shower, why was not the bright nucleus seen at the same time?

Prof. Adams: Tempel's comet may have been the nucleus. It may have a tail extending all round the orbit like the August meteors which are seen every year, although of long period.

Mr. Vignolles: The moment you admit the cometic principle, our orbit may intersect at any point.

Prof. Adams: I don't consider this a comet's tail in the ordinary sense.

The President: It may be there are ordinary comets and meteoric comets.

Capt. Noble: Biela's comet split into two. In such a case we might go through one part first, and then the other.

Prof. Adams: As Biela's comet has been referred to, I may say that at the time of its division it was passing very near the stream of the November meteors.

Mr. Lynn: It has been shown by Galle and Weise that the comet of 1861 passed near the meteors of April 20th. This comet had direct motion.

On the Determination of the Mass of the Moon by the range of Spring and Neap Tides: by Mr. Finlaison.

Mr. Stone: This paper is based upon an assumption which cannot be proved by physical reasons, and therefore must not be appealed to as a proof of the truth of the equation. The paper is rather an empirical formula for determining the height of the tides.

On two Small Errata in the Reduction of the Observations of the Eclipse of 1860: by the Astronomer Royal.

On some Errors in his Tables of Logarithms published in 1849: by General Shortrede.

On the Estimation of Star Colours: by Mr. Kincaid.

On the Numerical Data as to the Motion of the Solar System in Space: by Mr. Stone.

The author showed that out of the 1,167 stars having proper motion, used in Mr. Airy's investigation of this subject, there should be 291 cases of accordance in certain particulars only; but as he found 523 such cases, he considered the evidence in favour of a systematic drift either of the stars or our Sun preponderated.

The President: This is a most recondite investigation of the proper motion of the system, and I am always struck by the extreme honesty of the investigators, who are always on the lookout for possible errors on their own part. Mr. Airy did so with this subject, and Mr. Stone is equally scrupulous; but, notwithstanding, gets a little more bias towards the motion of our solar system in space.

On a Small Error in Le Verrier's Determination of the Solar Parallax: by Mr. Stone.

It has been ascertained that the final result of the investigation should be 8″·91 instead of 8″·95.

The President: What will that be in miles?

Prof. Adams: About half a million.

The President: It may be said this correction is almost another instance of astronomers being too open-mouthed. When the alteration of the parallax to the extent of nearly half a second was admitted, I remember its being observed that astronomy could not be the exact science it professed to be, as an error of three millions of miles was admitted in the Sun's distance; but I took occasion to show that it was an instance of its great accuracy, as it really came to measuring the diameter of a human hair placed at the distance of 124 feet, and the present is a case of still greater precision.

Mr. Stone: No one would say that we are sure of the distance to half a million of miles now; but a slight error having been discovered, it is right to announce it. Every method of getting the solar parallax is liable to some error.

The President: Then we must wait for the transit of Venus.

Professor Adams: No; I doubt that being the best method. I think the parallactic inequality of the Moon will do better, when we have got rid of the errors of the diameter and some other points.

Mr. Stone: The semi-diameter is not so accurately known as you imagine, and the whole error finds its way into the inequality.

Professor Adams: I hardly think the whole error gets in, nor that the effect is so important as Mr. Stone supposes. (Professor Adams gave the mathematical reasons for this opinion.)

Mr. Stone: The correction for the telescopic semi-diameter is very uncertain, as irradiation produces a sensible effect.

A Catalogue of New Stars: by Mr. Chambers.

On the Solar Eclipse of March 6, with a Photograph: by Prof. Piazzi Smyth.

On the Distribution of the Nebulæ in Space: by the Abbé Cleveland.

On the Eclipse of the Sun, and an Occultation of a Star by the Moon: by the Astronomer Royal.

Note on the Calculation of the Solar Parallax from the Lunar Theory of Hansen: by Mr. Stone.

The meeting then adjourned.

REMARKS ON THE CONNECTION BETWEEN COMETS AND METEORS.

By Dr. Edmund Weiss, of Vienna (*Ast. Nach.* 1632).
Translated by W. T. Lynn, Esq., B.A., F.R.A.S.

The recent interesting investigations of Schiaparelli and Le Verrier have, as is well known, led to the remarkable result that the meteoric showers of the 10–13th of August and of the 13th of November move in orbits which coincide with those of two of the known periodic comets, viz. III. 1862 and I. 1866. This fact, so highly important for the understanding the nature of both comets and meteors, admits of no other interpretation than that the body of a comet, in consequence of the cloud-kind nature of the state of aggregation in which we must necessarily consider it to be, can, when it approaches the Sun, partly on account of the change thereby produced in the conditions of stability of such systems of material points, and partly on account of the physical transformations which it undergoes, no longer subsist as a whole, but must repel to a distance individual particles which collect together under the former condition of aggregation about new centres of gravity, and, as is easily seen, will revolve round the Sun in orbits possessing great similarity to the orbit of the mother comet. Now, in the case of the periodical comets, such products of dispersion will gradually collect on the orbit of the comet along its whole extent, and these will, if the comet's orbit intersects that of the earth, or even nearly approaches it, produce, at the annual passage of the earth through the point of intersection, the phenomena which we call periodic showers of meteors.

According to this view, each periodical comet occasions the formation of a ring of meteors, and it will follow that the other periodic shooting-stars known to us, in addition to the above-named, must also owe their origin to the intersection of the earth's orbit with periodical comets. If, however, a comet belongs to the class not periodical, it will attract towards it an arc, if we may so call it, of shooting-stars, and this will produce one brilliant exhibition of those bodies, if the earth passes through it, but without giving rise to a periodically recurring meteoric shower.

In order to test the justice of these considerations, I calculated the radii vectores at the ascending and descending nodes for all the cometary orbits hitherto determined, and compared those nearly similar to the Earth's in radius vector, first with the meteoric showers recognised to be periodic. I found the following included in such, by consulting Humboldt's *Cosmos*, Quetelet's *Catalogue of Shooting-star Phenomena*, Heis's *Treatise on Shooting-stars*, &c., and have affixed to the uncertain ones a note of interrogation:—

1. January 1–4.
2. April 4–11 (?).
3. April 20–24.
4. May 26 (?).
5. July 27–29.
6. August 10–13 (the shower of Laurentius).
7. September 1 (?).
8. September 18–25 (?).
9. October 19–26.
10. November 13 (the oldest known shooting-stars).
11. November 28.
12. December 6–9.

For two of these showers, which have indeed been noted as very uncertain —namely, those of May 26 and September 1—I was able to find no cometary orbit whose nodes were situated in the regions which the earth passed at those times. But to five other epochs—namely, besides Nos. 6 and 10, also Nos. 3, 11, and 12—there correspond decidedly periodic comets. If we denote by r the radius vector of the comet in ascending (☊) or descending (☋) node, and by R the radius vector of the Earth when at the longitude it is in at the time t, we have—

t = April 20, Comet I. 1861 ☋ $R-r=$ 0·002, P=415 years.
t = Nov. 28, Comet of Biela ☋ $R-r=-$0·018, P= 6·6 „
t = Dec. 9, Comet IV. 1819 ☊ $R-r=+$0·085, P= 4·8 „

The five remaining times do not indeed correspond to any comets known with certainty to be elliptical; nevertheless, several cometic orbits approach the Earth's orbit very closely at those times. For we have—

No. 1, t = Jan. 3, Comet II. 1792 ☋ $R-r=-$0·073.
„ „ 4, Comet IV. 1860 ☊ $=-$0·025.
No. 2. t = Apl. 13, Comet of 1837 ☊ $R-r=-$0·021 (very uncertain orbit).
No. 5, t = July 27, Comet II. 1737 ☋ $R-r=+$0·005.
No. 8, t = Sept. 17, Comet I. 1790 ☋ $R-r=-$0·054 (uncertain orbit).
„ „ 17, Comet I. 1763 ☊ $R-r=-$0·016 P=1000 years.
No. 9, t = Oct. 19, Comet 1779 ☊ $R-r=+$0·024.
„ „ 20, Comet 1739 ☋ $R-r=-$0·078.
„ „ 21, Comet 1097 ☋ $R-r=+$0·056.
„ „ 24, Comet 1366 ☋ $R-r=-$0·054.

The intersection of the cometary orbits with the earth's orbit in those days, which are distinguished by periodic showers of shooting-stars, cannot, from what precedes, be looked upon in the majority of cases as a mere freak of accident; but there is, besides, a simple means of searching out those comets which stand in connection with the periodic shooting stars—I mean the calculation of the point of convergence belonging to each individual orbit, and the comparison of these with those deduced from the observations. With this calculation I am at the present time occupying myself, and will at the proper opportunity communicate the results. I consider, however, according to what has been said at the beginning, that out of the above, those comets which turn out to agree with the periodical shooting-stars must be looked upon as also periodical, and thus this investigation might lead to the detection of the periodicity of several comets, the observations of which have not sufficed to reveal it. Under these circumstances, the high importance which the investigation of the periodical shooting-stars, and the accurate determination of their points of convergence, have henceforward attained in cometary astronomy, stands in no need of any further enlargement.

In conclusion, I will add a few words on the peculiar fact that several of the periodical meteoric showers coincide with the simultaneous approach of the Earth to the orbits of several comets. This occurs both in Nos. 1, 8, and 9, and also in the Laurentius shower; whilst at the longitude 317°, besides Comet III. 1862, also Comet II. 1852 crosses the Earth's orbit. There is therefore manifestly a connection between the long duration of this periodic shower and the existence of several points of convergence for it. In the calculation also of the radii vectores the great number of approximations of cometary orbits to each other, which was too great to be purely accidental. As a proof of this, I will set down some of those approximations in the ecliptic, which occur in the neighbourhood of the Earth's orbit, remarking, however, expressly, that the data can by no means make any pretensions to completeness, and in the majority of cases give not nearly the closest approaches of the cometary orbits to each other, but only the distances of the orbits from each other in the ecliptic:—

Comet II. 1792	☋	I = 103°	r = 0·983.
„ IV. 1860	☊	104	0·985.
„ 1672	☋	117	1·046.
„ I. 1840	☊	119	0·948.
„ 1092	☊	125	0·977.
„ IV. 1854	☋	144	0·973.
„ IV. 1858	☋	145	0·973.
„ III. 1854	☊	168	1·025.
„ 1490	☊	168	0·960.
„ 1683	☊	173	1·047.
„ 1763	☋	176	1·020.
„ IV. 1862	☋	176	0·982.
„ I. 1830	☊	206	0·923.
„ 837	☊	207	1·026.
„ I. 1861	☋	210	1·003.
„ II. 1748	☋	213	0·886.
„ III. 1790	☋	215	1·052.
„ II. 1852	☊	317	1·025.
„ III. 1862	☋	317	1·019.
„ II. 1862	☊	327	1·039.
„ I. 1790	☋	353	1·058.
„ 1763	☊	356	0·974.
„ IV. 1864	☋	23	1·045.
„ 1779	☊	25	0·972.
„ 1739	☋	27	1·073.
„ 1366	☋	32	1·048.
„ I. 1766	☋	64	0·853.
„ Biela	☋	66	1·004.
I. 1743	☊	67	0·881.

In regard to some rich but isolated displays of shooting-stars, which have not been periodically repeated, I have already collected some data, which indicate their connection with comets which have crossed the Earth's orbit. I reserve, however, the publication of these until I have completely worked out the whole of the existing material.

Mr. Lynn adds, in a postscript dated April 13:—"You will perhaps also mention the confirmation of the identity of orbit of the shooting-stars of April 20 with the first comet of 1861, afforded by the calculations of Dr. Galle, to which I alluded at the Astronomical Society during the discussion on Mr. Adams's interesting paper last night. Dr. Galle determined from the elements of the comet the radiant point of the cometary particles, and found for its apparent place referred to the ecliptic at the time of our passage through the comet's descending node, Longitude = 267°·2, Latitude + 57°·0, agreeing within about 7° of a great circle with the best determinations of the radiant point of the April shooting-stars, which all observers place in the constellation Lyra. He also calculated an orbit for the meteors, assuming the periodic time (415 years), and major axis found by Oppolzer for the comet, and deduced the following comparison:—

	Meteors of the 20th April.	Comet I. 1861.
log. a	1·746	1·746
log. q	9·980	9·964
c	0·9829	0·9835
π	236°	243°
☊	30°	30°
i	89°	80°
	motion direct.	motion direct.

"The subject is one of great and increasing interest. It is to be hoped that we shall shortly obtain a better determination of the radiant point of the April meteors, which will be looked for on April 20th and a night or two succeeding that date."

THE LUNAR CRATER LINNE.

Translation by W. T. Lynn, Esq., B.A., F.R.A.S., of the Royal Observatory, Greenwich, of a communication by Herr J. F. Julius Schmidt, Director of the Observatory at Athens, on "The Lunar Crater Linné," to the *Astronomische Nachrichten.*

(Communicated by W. R. Birt, Esq.)

1. At the time of the labours of Lohrmann and Mädler, 1822–1832, Linné was a crater more than 5,000 toises (about six English miles) broad, and very deep, distinctly visible as a crater; when near the phase it was more or less overshadowed. It was the third in magnitude on the *Mare Serenitatis,* was seen and drawn by Schröter and also by myself in 1841–1843. At least since 1866, October 16, the crater form of Linné, at the time of oblique illumination, *cannot at all be seen.* The Athens refractor shows in the interior of its figure at times a fine black point 300 toises (1,918·4 English feet) in diameter.

2. In high illumination, Linné is always visible as a spot of light, and has certainly always been seen so for more than 20 years past.

3. In the discussion of the question raised by me, it is necessary clearly to bear in mind what the nature of the appearance of Linné for the course of years past has been, and how it has been related to other craters in the neighbourhood. If powerful eye-pieces, magnifying from 500 to 1,000 times, should occasionally give the idea of the crater form, it must, above all, be

stated *whether the crater was deeply shadowed, and had the old diameter.* If such were the case at present, neither would a large telescope be necessary, nor could the question ever have been raised at all.

4. It is impossible that Lohrmann and Mädler should have drawn Linné as a sharp crater, and even have selected it as a point of the first order, if it had at that time shown its present character. In four lunations I have convinced myself, both in waning and waxing moons, by the most careful and repeated observations, *that Linné can never be seen under any illumination as a crater of the normal type.* Consequently, a local change has taken place, concerning which I have expressed my views in a letter to Herr Haidinger at Vienna.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

PERFORMANCE OF OBJECT GLASSES.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The March number of the *Register* contains a paper by the Rev. W. R. Dawes, "On the Performance of Object Glasses," in which a reference is made to the performance of a 9-inch object glass by Slater, in the possession of a Manchester gentleman. As I am the only observer in Manchester who has a 9-inch telescope by Slater, I think it due both to Mr. Slater and to myself to give an explanation of the matter.

At the close of September last a friend of mine had an opportunity of observing with Rev. Mr. Lowe's 8¼-inch Alvan Clark telescope, at Atherstone, and on his return to Manchester he mentioned to me how very satisfactory was the performance of Mr. Lowe's telescope on γ^2 Andromedæ, which he saw fairly separated. He made me a rough diagram of the position of the companion stars from memory, which appeared to me somewhat different from a diagram I had made some time previously. I sent both to Mr. Lowe, requesting him to compare them with his own and let me know the result. I have not since heard from him, and I was quite surprised to find a reference made to my diagram in Mr. Dawes' paper. I mentioned to Mr. Lowe that my telescope was not yet adjusted. I should have added at that time (about the beginning of October last), that I had not then any illuminating apparatus to my telescope, and consequently could not use my micrometer. No man knows better than Mr. Dawes that, under such circumstances, the angle of position must be given only *by a rough estimation.* In fact, my diagram was sent to Mr. Lowe merely to draw out from him a more correct diagram, and a detailed account of the performance of his object glass. I may remark, that the diagram given by Mr. Dawes appears to me greatly exaggerated as to the *distance* of the components of γ^2 Androm.; I question if a 12-inch refractor would show them so much apart. According to Mr. Lowe's letter in the last number of the *Register*, his friend only saw a dark line between *B* and *C*, and it was not until the night of January 3 of the present year that Mr. Lowe himself saw the companion thoroughly divided into two with a power of 292. It is clear that the eye of Mr. Lowe's friend was better than his own, and that the eye of Mr. Dawes was superior to both; but there can be no doubt about the performance of the telescope. From various causes I have not been able to do anything in my observatory since October last; but having now got my telescope in working order, I expect very soon to try its performance again upon γ^2 Andromedæ.

I have no doubt whatever of having fairly divided the small stars on the 21st and 31st of August last with 8-inch aperture, and power of 850. It appears that Sir W. R. Murray only separated the stars with 720 and 850, 9-inch aperture. I cannot place the stars so much apart as in Mr. Dawes' diagram, even with a power of 1120. I consider, therefore, the performance of Mr. Lowe's telescope very extraordinary, in thoroughly dividing the stars with a power of 292. I remain, yours truly,

St. Luke's Rectory, Manchester: W. A. DARBY.
March 15, 1867.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I have been very much interested in the paper by Mr. Dawes in your last number, on γ^2 Andromedæ and δ Cygni; and if you will kindly allow me a little space, I wish to call attention to the remarkable and instructive agreement between theoretical inference and practical experience, which the following quotations show. Mr. Dawes says, speaking of δ Cygni, "The difficulty here is, of course, not to *separate* the stars, but to place *B* out of the way of the bright ring surrounding *A*, which is usually too bright to permit *B* to be distinctly and certainly seen through it. An aperture of 4 or 4¼ inches may show *B* just *within the ring*; but to diminish the radius of the ring's exterior edge to 1″·7, requires an aperture of 5¾ inches at least." Now, in the *Register* for December last, your correspondent, signing himself "Another Subscriber," says (page 317), that, "with my own 4·2-in. glass, by the late Andrew Ross, with a power of 394, ... on a fine night, I have seen the companion of δ Cygni as a faint green dot, interrupting the rings round the larger star, and fairly divorced from it." The correspondence between the two statements could not well be more complete. It is also very interesting, in reference to Mr. Dawes' remarks on γ^2 Andromedæ, to find that on the Peak of Teneriffe, at an altitude of 10,710 feet above the sea, Cooke's Equatorial, of 7·5 inches aperture, divided the star, night after night; *i.e.*, "there was a dark line between them, *but the disks were somewhat compressed on that side.*" [Monthly Notices R. A. S., vol. xvii, p. 111.]

I remain, Sir, yours truly,
Edgbaston: March 13, 1867. GEORGE HUNT.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Referring to Mr. Dawes' very interesting communication in the last number of the *Register*, I there find it stated that a fine achromatic object glass, of NOT LESS than 7¾ inches, is necessary to fairly divide γ^2 Andromedæ, and that an aperture of 7½ may be required to give even the appearance of a division.

I have in my possession a silvered-glass speculum, which was parabolised for me by Mr. With, of 6½ inches aperture, and 4 feet 10 inches focus. This mirror divides γ^2, as does also another of 6¼ inches in the possession of Mr. Slack.

These circumstances I have mentioned to Mr. De la Rue, who said that he saw nothing improbable in the statement.

More recently I have spoken on the subject to Professor Hamilton Smith, of Kenyon College, Ohio, and this gentleman says that he knows of a 6-inch metal speculum in America which doubles γ^2. It would appear, then, that the superior dividing power of reflectors over refractors must be admitted.

I am, Sir, your obedient servant,
Upper Holloway: March 2. JOHN BROWNING.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—It is evident from all that has been said about γ^2 Andromedæ, that it has never been seen divided, except in very large telescopes. But here is the passage from Loomis's 'Progress of Astronomy' (1856; Low), page 389:—"He (*i.e.* A. Clark) made a telescope of 5¼ inches aperture of Guinand glass, which was sold to Mr. Welles, of Newburyport. This telescope separated the close pair in the triple star Gamma Andromedæ, whose distance is ⅖ths of a second, and showed the sixth star in the trapezium of Orion, though with difficulty."

Here is evidently a contradiction, as the latter is far less difficult than the former. That it divided γ^2 Andromedæ, "Credat Judæus non ego." With regard to the companion of δ Cygni; while Mr. Knott says that it has been seen by a 4·14-inch o.g., Mr. Dawes, I observe, says that it requires a 5¾ aperture to see it well. Perhaps the 4·14-inch was the aperture of a large telescope reduced, accompanied with "manipulation," and a very favourable state of the atmosphere. The visibility of very difficult objects depends generally on concurring circumstances; and a little experience makes one somewhat incredulous, especially when it is found that first-rate telescopes do not always show them.

March 7, 1867. A SUBSCRIBER.

CELESTIAL PHOTOGRAPHY.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Your correspondent "R. C. H." has not, I think, taken into account the extremely small surface covered by the image of a planet when seen at the focus of the telescope after the eye-piece has been removed. If a piece of ground glass be held against the tube of the telescope when the eye-piece is taken away, nothing will be seen but a point of light, which in a large instrument might be about the size of the smallest letter o on this page. Any attempt to photograph the image after it has been magnified by the eye-piece could not be very successful, owing to the loss of light; and the most perfect driving clock would fail to keep the image sufficiently steady to enable it to bear subsequent enlargements.

A little reflection will show that we can never obtain photographically such perfection of definition on such small objects as we can by direct vision through the telescope. The state of the atmosphere affects the image just the same in both cases; but the collodion film cannot accommodate itself as the eye does, and so take advantage of the clear intervals which occur even on bad nights. Therefore, if we obtain a moderately perfect image, say of one-twentieth of an inch in diameter, we could not expect a collodion film to bear anything like a power of 300 or more, or to find the details which may only be seen by direct vision under the most favourable atmospheric conditions, and when much greater magnifying power may be used.

The moon gives a comparatively large image, varying with the focal length of the object glass; and when the deposit of silver forming the picture is very fine, the enlargement may be good up to 3 feet or more, and, if viewed at a proper distance, it will look extremely well magnified to 15 or 20 feet by means of the oxy-hydrogen lantern. To obtain this very fine deposit of silver is one of the greatest difficulties in astronomical photography. The best pictures of the moon yet made show defects from this cause alone.

I shall be glad to hear that some of your readers have been more successful than I have in photographing the planets.

Manchester. A. BROTHERS.

THE NAUTICAL ALMANAC.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—"Athleta" has stated in his letter some difficulties which he has met with in the explanation of the Planetary Ephemerides at Transit, p. 537 of the *N. A.* I will endeavour, with your permission, to furnish a reply to his questions.

1. The variation in 1h. of long. given in the table must only be taken to indicate the rate of the planet's apparent motion in R.A. (or Dec. as the case may be—the method is the same in either case) *at the moment of the planet passing the meridian of Greenwich*; but this rate may or may not be the same as that in the preceding or succeeding 48h.; if it were the same, "Athleta's" result would be correct. Thus, in the example furnished, the error in "Athleta's" method is that he assumes the planet to have had the *same* apparent rate of motion in R.A., when it was 4h. east of the meridian of Greenwich, as that assigned in the table, viz, 13·62s.; but a reference to p. 306, col. 4, shows that during the preceding 48h. its apparent rate of motion has been *increasing*, as the var. on the 21st August was only 11·63s. Consequently, when the planet was 4h. east of the meridian of Greenwich, its rate of motion in R.A. for 1h. of long. was something less in value than 13·62s.; and its *average* rate during that 4h. is obviously that which it had at long. 2h. east; i.e. "midway between Greenwich and the place at which the R.A. is required," viz. 13·54s.

2. On referring again to p. 306, col. 4, it will be seen that the vars. are given at intervals of *two* transits—e.g. the var. for Aug. 23 is 13·62s.; the var. next above is 11·63s., which corresponds to Aug. 21st.

3 and 4. The difficulties here stated will vanish if it be but clearly understood, as stated above, that the var. given in the table only indicates the rate of the planet's apparent motion in R.A. at that particular moment of time when it is on the meridian of Greenwich; that is, *if its rate continues the same* for the next 1h. of long., its variation in R.A. will then amount to 13·62s. (Aug. 23), *but not otherwise*. Consequently, before such correction can be applied for any long. E. or W. of Greenwich, it is necessary to ascertain what has been or will be its *average* rate of motion in R.A. during the time corresponding to the given long. E. or W., which is found (approximately) by the method given in the explanation, p. 537.

With respect to the use of the transit instrument. The second ephemeris (at transit) of the planets contains all that is necessary, and is the most ready and accurate, if the observer be furnished with a clock keeping sidereal time, the time of transit being indicated by the given R.A. corrected as on p. 537. If an ordinary clock is used, col. 5 of the first ephemeris furnishes "a short and easy method of discovering the watch-error, without the trouble of reducing sidereal to mean solar time."

I remain, Sir, yours faithfully,

Alton, Hants: Feb. 1867. ALFRED W. DEEY.

DIVERGENCE OF THE SUN'S RAYS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—May I hope, through the medium of your proposed "Notes and Queries," to obtain from some of the readers of the *A. R.* a solution of the following question, namely: Why is there so great a divergence in the Sun's rays after having passed through openings in the clouds? the divergence being apparently as great as it would be were that luminary comparatively near, instead of its real distance of more than 90,000,000 of miles. A considerable divergence may be observed in rays that have passed through a single opening of the clouds in their passage to the earth.

I am, Sir, your obedient servant,

BETA.

BRIGHT SPOT ON THE MOON.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—At 7h. 30m. on the 9th inst., while waiting for the occultation of 130 *Tauri*, I was surprised to observe a spot on the dark side of the moon's disc, nearly equal in brightness to a star of the 7th mag.; it was so conspicuous that it could not possibly have been overlooked by the most careless observer.

Unfortunately, I was unable to fix its position with accuracy; but after careful consideration, I think its place was nearly, if not quite, identical with that of *Aristarchus.*

The outlines of the various "seas" and of a few of the larger craters on the NE. and SE. quadrants were very plainly seen; *Grimaldi*, especially, was remarkably distinct.

I watched the spot from 7h. 30m. to 8h. 30m.; at about 8h. 15m. it became much fainter; and on returning to my observatory at 9h. I could scarcely perceive any trace of it.

Although I have observed very similar phenomena on former occasions, yet I have never before seen a spot on the dark side of the moon with such remarkable clearness.

The definition on the evening of the 9th inst. was bad, but the atmosphere was unusually clear.

Powers used: 75 and 115 on 4 inches aperture, by Cooke.

I am, Sir, yours faithfully,

Bedford: April 12th, 1867. T. G. E. ELGER.

THE SATELLITES OF SATURN.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—As Saturn will shortly be well situated for observation, can you give your amateur readers some advice enabling them satisfactorily to identify the smaller satellites? I believe I see six in my 5-in. O. G., though Mr. Chambers says in his new volume that it requires a 6-in. O. G. to see Enceladus. He also says that to see Mimas with a 9½-in. O. G. is an exceptional case. I am, however, informed that the 8¼-in. O. G. by Alvan Clark shows all the eight satellites distinctly; and has it not been stated more than once in the *Astronomical Register* that Enceladus is visible with comparatively small instruments? Mr. Webb speaks of Enceladus and Mimas as having been seen with 4¼ aperture, but this statement appears to require confirmation. How is it to be explained that a 5-in. O. G., which shows very clearly and distinctly the small star in 14 Monocerotis, classed as 16th magnitude, fails to show the satellite of Neptune, reckoned as a 14th magnitude?

Yours, &c.,

D. T. K.

March 1867.

In his diagram of Saturn and his satellites, p. 142, Mr. Chambers only represents seven as the number, which is evidently a mistake of the engraver.

REFRACTION.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—In answer to the enquiries of your correspondent "N.," I beg to say that my library is not without treatises on Optics, and that I have read Professor Smyth's account of his observations at the Peak of Teneriffe, where, with a clearer atmosphere, an observer obtains the advantage of a much greater illuminative power, from the light diffused by refraction over a wider horizon than he could command at sea-level.

That rays passing through the atmosphere are made, by refraction, convergent at one point and divergent at another, and that much light is thus directed to the eye which would otherwise never reach it, I presume no astronomer doubts, although by everyone the knowledge is not applied. A sufficient illustration of the principle is the familiar fact that the sun (or rather the spectrum which represents that luminary) is made by refraction to appear, at sunrise, above the horizon, while, by calculation, the orb itself is known to be still below it.

For some explanation of the mode in which refraction acts in altering, distorting, and magnifying the heavenly bodies, I may refer "N." to the fifteenth lecture of Arago's *Popular Lectures on Astronomy*; admitting that, after all explanation, the question of how the stars become visible is surrounded with difficulties. With which, if "N." be unacquainted, let me recommend him to take up the subject where I began it forty years ago, with the study of Berkeley's *Theory of Vision.*

Your obedient servant,

Fairseat, Wrotham: W. E. HICKSON.
April 6, 1867.

REVIEWS.

The Handbook of Astronomy. By Lardner and Dunkin. London: James Walton.

It is not very long since a lecturer was explaining some astronomical facts to his pupils; and in order to set the matter clearly before them, he referred to more than one large and important volume on the subject, but without a decidedly satisfactory result. One of the pupils, however, produced from his pocket a small unpretending work (Dr. Lardner's *Handbook*), and that which a lengthy paragraph in the larger work had failed to make clear, was completely elucidated in a short pithy sentence in the small book. It has often been remarked that Dr. Lardner, beyond most others, was enabled to present the gist of a matter before the reader in the fewest words. A third edition of the well-known *Handbook of Astronomy* is now before us, edited by Mr. Dunkin, of the Greenwich Observatory, who has added to the text all that has lately been discovered, so as to bring the work down to the present time. We can cordially recommend it as most useful to all those who desire to possess a complete manual of the science and practice of astronomy in a portable and inexpensive form.

Falling Stars: being an Account of the Meteoric Shower of November 13-14, 1866. By the Rev. J. Crampton, A.M., Author of 'The Lunar World,' &c. London: Macintosh.

A pleasing popular account, which will be acceptable to many persons.

ASTRONOMICAL OCCURRENCES FOR MAY 1867.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
						Saturn —
Wed	1	 1 15 2 20 22 53 23 46	Sidereal Time at Mean Noon, 2 35 47·1 Occultation of Venus Reappearance of ditto Occultation of Mercury Reappearance of ditto	2nd Tr. E.	15 27	12 41·3
Thur	2					12 37·1
Fri	3	19 40	● New Moon			12 32·8
Sat	4		Meridian passage of the Sun, 3m. 19s. before Mean Noon			12 28·6
Sun	5			1st Tr. E.	14 38	12 24·5
Mon	6	8 4 8 41	Occultation of 117 Tauri(6) Reappearance of ditto			12 20·2
Tues	7	8 11	Conjunction of Moon and Uranus, 5° 16′ N.			12 15·9
						Moon. —
Wed	8			2nd Tr. I. „ Sh. E.	15 13 15 30	4 11·7
Thur	9	13 55	Conjunction of Moon and Mars, 5° 31′ N.	3rd Oc. D.	14 50	5 9·2
Fri	10	10 4 10 48	☽ Moon's First Quarter Near approach of Moon to ξ Leonis (6)			6 3·7
Sat	11	12 27	Opposition of Saturn	1st Ec. D.	15 36 1	6 55·2
Sun	12			1st Tr. I. „ Sh. E.	14 15 15 15	7 44 2
Mon	13					8 31·2
Tues	14					9 17·1
Wed	15	10 1	Near approach of Moon to *m* Virginis (6)	2nd Sh. I.	15 10	10 2·5

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Thur	16		Sidereal Time at Mean Noon, 3 34 55·4			Moon. 10 48·0
Fri	17	11 28 11 57 12 59	Conjunction of Moon and Saturn, 1° 56′ S. Occultation of o^2 Libræ (6) Reappearance of ditto	2nd Oc. R.	15 55	11 33·8
Sat	18	1 52	○ Full Moon			12 20·3
Sun	19			1st Sh. I.	14 48	Saturn 11 25·1
Mon	20	16 0	Conjunction of Venus and *o* Piscium, 2m.·5 W.	1st Oc. R.	15 38	11 20·9
Tues	21		Declination of Saturn −15° 25′ 37″	4th Oc. D.	15 33	11 16·7
Wed	22					11 12·5
Thur	23		Meridian passage of the Sun, 3m. 32s. before Mean Noon			11 8·2
Fri	24					11 4·0
Sat	25					10 59·8
Sun	26	5 22 9 3 15 7 15 46	☾ Moon's Last Quarter Conjunction of Moon and Jupiter, 2° 17′ S. Occultation of 78 Aquarii (6) Reappearance of ditto			10 55·6
Mon	27			3rd Tr. I. 1st Ec. D.	13 16 13 52 8	10 51·4
Tues	28			1st Sh. E. „ Tr. E.	13 30 14 53	10 47·2
Wed	29			4th Sh. I.	13 16	10 43·0
Thur	30	21 26	Conjunction of Moon and Venus, 2° 4′ N.			10 38·8
Fri	31	6 55	Superior conjunction of Mercury.	2nd Ec. D.	15 30 9	10 34·6

THE PLANETS FOR MAY.

Mercury is not well situated for observation this month, being too near the Sun, with which he comes into superior conjunction on the last day of the month.

		h.	m.	s.			°	′		
1st	R.A.	0	59	17	Decl.	+	3	9½	Diameter	6″·8
15th	„	2	19	44	„		11	49	„	5″·6

Venus is decreasing in diameter, but still may be observed as a transit object in the morning, passing the meridian between half-past nine and ten o'clock in the morning during May.

1st	R.A.	0	14	5	Decl.	—	0	12½	Diameter	14″·0
15th	„	1	15	36	„	+	6	1	„	12″·8

Illuminated portion of the disc of Venus, 0·809.

Mars may still be observed in the evenings, setting about one o'clock in the morning at the beginning, and about midnight at the end of the month.

1st	R.A.	8	21	9	Decl.	+	21	30½	Diameter	7″·6
15th	„	8	49	28	„		19	33	„	7″·0

Illuminated portion of the disc of Mars, 0·904.

Jupiter may be seen in the morning, rising about two hours before the Sun at the beginning of May, and three hours at the end of the month.

1st	R.A.	22	20	22	Decl.	—	11	16	Diameter	34″·6
15th	„	22	27	52	„		10	36	„	36″·1

Saturn is now at its best position for observation for this year, coming into opposition on the 11th of May. The altitude of the planet is still decreasing.

1st	R.A.	15	19	18	Decl.	—	15	48½	Diameter	16″·8
15th	„	15	15	7	„		15	33	„	16″·8

Dimensions of Ring—Outer Major Axis, 42″; Outer Minor Axis, 16″.

Uranus may still be observed in the evenings.

5th	R.A.	6	24	19	Decl.	+	23	39	Diameter	3″·8
17th	„	6	26	43	„		23	37½		

The Minor Planet **Ceres** arrives at opposition on the 20th of this month, and appears about the seventh magnitude.

1st	R.A.	16	8	0	Dec.	—	13	34
21st	„	15	50	15	„		13	39

Pallas also comes to opposition in May, on the 5th. This planet is about the eighth magnitude.

1st	R.A.	15	42	30	Dec.	+	23	54
21st	„	15	26	0	„		26	11

OCCULTATION OF 130 TAURI, April 9th, observed by Mr. G. J. Walker, at Teignmouth, South Devon.—Immersion 7h. 15m. 6·6s. T.M.T. Power 64, fair observation; dark limb of moon visible.

THE NAUTICAL ALMANAC.—It is now one hundred years since the first appearance of this indispensable publication (1767).

INSTRUMENTS, &c. FOR SALE.

These Notices, which are restricted to *two lines* each, are inserted free of charge to subscribers: applications respecting prices and other particulars to be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent*.—For Advertisements with prices and more complete details, a small charge will be made.

N.B.—It is particularly requested that we may be informed when instruments are disposed of, in order that the notice may be withdrawn, and fruitless applications prevented.

Achromatic Refractor, 6·4 in. ap. 8½ ft. focus, by *Merz*, Equatorial and clockwork by *Troughton & Simms.* **[73]**

Achromatic Refractor, 4 in. aperture, by *Cooke & Sons*; equatorially mounted, complete in every respect. **[104]**

Achromatic Refractor, 4 in. ap. 5 ft. focus, by *Dollond;* equatorially mounted. Powers up to 400. **[87]**

Gregorian Reflector, 4¾ in. ap. 2 ft. focus, by *Dollond*, 4 powers, 50 to 200, finder, &c., on brass table stand. **[63]**

Achromatic Object-Glass, 4⅛ in. ap. 62 in. focus, by *Slugg*, with brass cap and receiving cell, for mounting on tube. **[85]**

Newtonian Reflector, Equatorial motion, metal 7⅞ in., first-class quality; price very low. **[100]**

Silvered Glass Speculum, 10⅛ in. diameter, 7 ft. focal length, of excellent quality, by *Mr. With*, in wooden tube; price moderate. **[101]**

Transit Instrument, 3¾ in. ap. 5 ft. focus, Ys fitted with agates for mounting on stone piers. **[29]**

Two Equatorial Stands, for 5 ft. telescope: with circles, &c. complete. **[99]**

Equatorial Stand, for a 5 or 6 ft. telescope: 13 in. circles, divided on silver, to 10″ of space and 4s. of time.—Has never been used. **[55]**

Transit Instrument, ap. 2½ inches, by *Jones*, Charing Cross: with three circles, divided on silver. **[98]**

Varley Stand, improved, rackwork movements, for a telescope of 5 or 6 ft. focus: on circular turn-table, to point in any direction. **[16]**

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Speculum Grinding Apparatus, capable of working a 7 ft. speculum: with tube and fittings for a 9 in. Newtonian. **[57]**

Observatory, Wooden, remarkably well constructed, 10 ft. sq. **[103]**

Recreative Science: and the first three volumes of the **Photographic Journal**: price very low. **[30]**

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Astronomical Clock, not very first-class; price low. **[65]**

Equatorial Stand, for a 5 ft. Refractor: graduated circles. **[35]**

Transit Instrument, 2 in. ap. 18 or 24 in. focus. **[71]**

Transit Instrument, 2 in. aperture, about 20 in. focus. **[102]**

Monthly Notices of the Royal Astronomical Society, Vol. 3. **[26]**

Monthly Notices: Vol. 5, No. 12. **[82]**

Bartholomew Prescot on the Universe, published 1823: a copy wanted, in good condition. **[84]**

BRIEF CORRESPONDENCE.

ROUGH EDGE OF THE MOON.—Your correspondent "Readingensis" is under a very great mistake about the bright edge of the moon always presenting a smooth portion of a well-defined circle. I have often noticed depressions and ridges in profile, but never so distinctly as this evening (April 11th), when viewing that luminary with a friend. There were several ridges and peaks surrounding depressions most distinctly seen; the evening being remarkably still, after wind and rain. I presume that much will depend on the *libration* as to whether a comparatively smooth surface or a broken one is visible. S. B.

THE ZODIACAL LIGHT.—Might I be allowed to ask, through the medium of your pages, whether *Spectrum Analysis* has been applied to the Zodiacal Light, and if so, what have been the results? and what conclusions have been come to as regards its nature? JAMES J. COATES.

SOLAR ECLIPSE.—I had expected before this to see an answer to my question as to whether the great Solar Eclipse of August 1887 would be total anywhere in Great Britain, but have not yet seen any answer. It would greatly oblige me if some one of your correspondents would notice this. CURIOSUS.

ZADKIEL!—No doubt many of your readers have seen Mr. Zadkiel's novel way of calculating the distance of the sun's body from the earth: will any one of them undertake to say Mr. Zadkiel is right, and all astronomers are wrong, and where the wrong one is in error?

A CONSTANT SUBSCRIBER.

MAP OF THE MOON.—It might be well if Mr. Webb, in the new edition of his *Celestial Objects*, published his map of the Moon by itself, as well as in the book: this would make it handy for the observatory.

G. J. W.

LIST OF SUBSCRIBERS—Name received since our last number.

Linwood, Rev. W., Winchfield, near Birmingham.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To April 1867.
Cook, J. L.

To June 1867.
Barlingham, R.
Crowe, Rev. R.
Jackson, Mrs. H.
Linwood, Rev. W.
Sargent, Rev. J. P.
Shawcross, W.

To September 1867.
Alsager, J.
Birt, W. R.
Herschel, A. S.

To October 1867.
Elger, T. G. E.

To December 1867.
Bazley, T. S.
Dobie, Dr.
Weldon, Mrs.

NOTICES TO CORRESPONDENTS.

Correspondents communicating with the Editor are particularly requested to notice the change in the address to Parnham House, Pembury Road, Clapton, N.E., instead of Stamford Villa, as heretofore.

Numerous communications are unavoidably delayed.

Papers from R. H., S. B. K., W. R. B., and G. J. W. are in type.

Mr. Joynson requests us to make the following correction:—In the report of his paper on Mars, in our last number, p. 79, lines 19 and 20, for "*one* band near the South Pole," read "*the* band in the southern hemisphere."

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 54. JUNE. 1867.

ROYAL ASTRONOMICAL SOCIETY.

Seventh Meeting, May 10, 1867.

The Rev. C. Pritchard, M.A., F.R.S., *President*, in the Chair.

Secretaries—Mr. Stone and Mr. Huggins.

The minutes of the last meeting were read and confirmed.

Thirty-two presents were announced, and the thanks of the meeting voted to the respective donors. Two curious works had been purchased for the library by the Turner Fund—the one, a tract, dated 1504, on The Various Appearances in the Air, by Petrus de Eliacus; and the other, Astronomical Tables, dated 1657.

James W. Bosanquet, Esq., and John Joynson, Esq., were balloted for, and duly elected Fellows of the Society.

The following papers were read:—

On Comet II. 1867: by Mr. Talmage.

Observations were made in April and May, of which the details were given. The comet was very faint.

Mr. Stone stated that two meridional observations of the comet had been obtained at Greenwich.

The President: This comet has not been identified with any meteors.

Mr. Stone: Not at present.

On the Occultation of Mercury: by Capt. Noble.

The observations were made at Maresfield; but the planet was wretchedly defined on a strongly illuminated hazy sky, and seemed to fade out at 22h. 54m. 55s. L.M.T. The Moon's limb was not visible.

On an Error in the printing of his Paper on the Solar Eclipse: by Mr. Brothers.

In his letter of March 7th, he described the Sun as *steady*, which had been misprinted *shady*, by which the sense had been destroyed. Mr. Brothers found the weather much better than it appeared to have been elsewhere. He was surprised to find the mountains on the Moon's edge were not generally seen, as it was very rough to his eye, and one spot on the Sun quite distinct, although most accounts said no spots were visible.

The President and Mr. Stone related a number of other misprints which had recently occurred in the Monthly Notices, much to their annoyance.

On the Distribution of the Nebulæ in Space: by Mr. Cleveland Abbe.

Those who realize the incompleteness of our knowledge on the subject of the positions and nature of the so-called nebulæ, are agreed on the need of more systematic observations in both hemispheres. In view of the anticipated publication of Mr. Lassell's observations at Malta, and of the revelations to be expected from the 4-foot mirror making by Mr. Grubb, Mr. Cooke's 25-inch and Clark's 18-inch objectives, it seems natural to defer speculation to a future time; but the publication of Sir J. Herschel's General Catalogue of nebulæ and clusters enabled the author to gain some knowledge of the law of the distribution of these bodies, some of the most obvious results having been already indicated in Sir J. Herschel's 'Cape Observations.' Herschel's investigations relate to 3,812 nebulæ and clusters visible in the 18-inch reflector at Slough and Feldhausen, while his Catalogue of 1864 contains 5,079 objects. These were arranged in groups, having sides of 0h. 30m. in R.A. and 10° in N.P.D., and the positions of the Via Lactea and the two Nubeculæ indicated, which showed that the latter were distinct groupings, and isolated from the Via Lactea. Neither are they centres of condensation for the whole system, which, on the contrary, has a decided tendency to increase towards the poles of the Via Lactea (R.A. 0h. 47m., N.P.D. 64°; and R.A. 12h. 47m., and N.P.D. 116°).

The paucity of nebulæ and abundance of clusters near the Via Lactea has been before noticed. Tables of these clusters were prepared, and 637 objects showed their condensation in the Via Lactea and Nubeculæ obviously. A third table of resolved or resolvable nebulæ showed that of 397 such bodies, 12 only are within the borders of the Via Lactea. A fourth table includes the 4,053 remaining objects, of which 64 lie within the Via Lactea. The tables having been given, the following results are deduced:—

1. The clusters are members of the Via Lactea, and are nearer to us than the average of its faint stars.

2. The nebulæ lie in general without the Via Lactea, which is therefore essentially stellar.

3. The visible universe is composed of systems of which the Via Lactea, the two Nubeculæ, and the Nebulæ are the individuals, and which are themselves composed of stars (either simple multiple or in clusters) and of various bodies of both regular and irregular outlines.

The paucity of nebulæ near the Via Lactea might, perhaps, be attributed to the overpowering light of the stars condensed there; but as increase of telescopic power has not largely increased the number of nebulæ near the Via Lactea, it may be presumed that the greater portion of the existing nebulæ in that direction have been discovered. The paper concludes with some further speculations on the distances and nature of the various classes of clusters and nebulæ, and the possibility of light undergoing some modification in its nature in passing through immense distances of imperfectly elastic ether.

The President: Very few philosophers have discussed this question of the distribution of bodies in space, and it is therefore refreshing to find the subject taken up by a competent person. We need not be surprised when we find this paper comes from a gentleman now studying at Pulkowa, as it shows the spirit of Struve still in the ascendant.

Mr. Stone: The condensation of the nebulæ about the poles of the Via Lactea was indicated by Herschel, and the other conclusions of the paper were shadowed forth by him. There are great difficulties with respect to Struve's views of the distances of the stars, and the possible effect of space upon light.

The President: Our written papers are exhausted, but much remains behind of an oral nature which will be deeply interesting. Mr. Alexander Herschel has a communication to make; Mr. Browning has views of Mars to exhibit and describe; and principally we have Mr. Dawes' valuable and important paper to discuss. No one can have read it without being impressed by its numerous points of interest, and I now fulfil my promise of calling for observations upon it. By a happy coincidence Mr. Dawes is present, and I trust that many of our astronomers will have something to say on the subject.

The Astronomer Royal: I have read Mr. Dawes' paper with the greatest pleasure, and having known him upwards of 30 years, and respected his talents, and believing he has an ocular vision more accurate than any other person I have come across, I am delighted to see the cream of his observations collected in the manner he has done. There are two points in the paper to which I wish to refer—the one physiological, the other optical. Mr. Dawes has noticed the tendency of stars to assume at times a triangular figure, which may be corrected to a certain degree by optical arrangements, and this appearance is apt to come on at odd times, such as late in the night, after long gazing, &c. Now, I remember, about 1832, Sir D. Brewster speaking to me about certain disturbances of stars, and their tendency to the triangular form, and he attributed it to a tendency in the human eye to divide rays into three, under the influence of fatigue or disordered functions of the body, and he connected it in his own case with a state of stomach which required a course of medical treatment. He subsequently published a paper on the subject, which I have not been able to find on looking for it to-day; but I will resume the search, and when successful communicate further to the Society. In my own experience, it was only on one occasion, when, under the influence of great grief, my brain was shaken and my eye moist and dim, that I saw the stars with three rays and hyperbolic curves between, and this was distinctly attributable to my state of mind. The other point I would remark upon is the different focus required for high and low stars. I have no doubt whatever that, do what we will, we cannot get the rays to arrive at the eye in the same position. With a low star, the rays, to use a carpenter's expression, come *plumb* to the eye; but with a high star, twist about the body as we may, the rays come through the upper part of the eye in a skew direction.

The President: Mr. Dawes refers the triangular form to the east wind.

The Astronomer Royal: Which disorders everybody's stomach. There is a 500-year old proverb—

> "When the wind is in the east,
> It is not good for man or beast."

The President: Mr. Airy gives a physiological explanation of the form—let us hear what Mr. Huggins has to say on the subject.

Mr. Huggins: I have paid particular attention to the phenomena, and corresponded with Mr. Dawes on the subject. I can hardly attribute the shape to physiological causes, as some nights are what may be called eminently triangular; and apart from fatigue or state of body, you see, directly you look through the telescope, that the night, however fine, is useless for observation. On other occasions there are fits of distortion and intervals of fine definition, alike opposed to the theory of the causes mentioned by Mr. Airy.

The Astronomer Royal: I founded my remarks on Brewster's experience, who found the distortion disappear after a course of medicine.

Mr. Dawes: If this theory be true, the telescopic appearance of stars would be a good criterion for a physician.

The President: The thing that struck me most, and no doubt has struck Mr. Airy also, is the remarkably clever way in which Mr. Dawes got rid of the triangular shape by a peculiarly formed aperture.

The Astronomer Royal: I don't think I ever saw (save once, as mentioned) any defects of figure requiring correction.

Mr. Browning: I remember that Sir William Herschel, in some of his papers, stated that he found such a defect, and adopted some such mode of cure.

Mr. Dawes: Mr. Airy has adverted to fatigue of the eye, and observing at unearthly hours, as causes of the defect; but I have found it exist directly I sat down to the telescope on an apparently fine night, and I then at once gave up observing. In my paper I adverted to a striking instance when Mr. Alvan Clark and myself both saw Arcturus triangular, and found that changing the object-glass produced no change in the star. The wind was south-east, but calm. [Mr. D. here quoted the passage at length from the Monthly Notices.]

The Astronomer Royal: Did you both observe with the same eye?

Mr. Dawes: I used the right eye. I am nearly, but not quite, sure Mr. Clark did also.

The President: Mr. Dawes mentions another important circumstance, that on one night, after observing for some hours, he found the triangular appearance come on, and upon going out of the observatory he discovered that the wind had changed to the east.

Mr. Huggins: It is also desirable to bear in mind that a low power not being sufficient to raise a disc, the triangle form will not be seen with it. A low power gives only a point of light; but to raise a disc and show the distortion requires a high power.

Mr. Vignolles: With respect to the triangular appearance, it has happened to me from boyhood, and I daresay to many others, that, when lying awake in the dark, either with or without rubbing the eyes, certain luminous figures appear. In my case they come without rubbing or pressing the eye; and although at first, circular, elliptical, or otherwise convoluted, invariably resolve themselves into triangles. It may be an effect peculiar to myself, but deserves statement.

The President: If we met many persons similarly affected, we should no doubt regard it as a physiological fact.

Mr. Stone: I should like to know whether there is any relation between the vertex of the triangle and the position of the eye?

Mr. Dawes: It makes no difference whatever.

Mr. Stone: Or as to the pole of the earth?

Mr. Dawes: Wherever the star may be, the base of the triangle is nearly parallel to the horizon.

Capt. Noble: I can entirely corroborate what Mr. Huggins has said as to a high power being necessary to see the shape of the disc.

The President: Of course, if you can't see a disc at all, you can't tell its shape.

Capt. Noble: If the triangle were due to a physiological cause producing an optical defect, the eye would make a triangle from a point; but I am very much indisposed to accept Mr. Airy's theory. I am well acquainted with the effect, and, so far as indigestion is concerned in its production, I don't know what that is. In fact, if Darwin's theory be correct, I must have had an ostrich for my ancestor. I rose, however, more especially to advert to the other point—viz., the shortening of focus with low stars—and to observe that, instead of its being due to the position of the eye, I should be disposed to refer it to the great amount of mist in the lower atmosphere. I have narrated, in a paper to this Society some years ago, that when using a large field low-power eyepiece on the Sun, I observed the focus alter, and found a thick haze had come up—that I marked the focus, and, measuring the difference, found it 1-10th of an inch less than usual, and that when the haze disappeared, the focus altered back again to my usual point. Had it not done so, I might have thought my eye or stomach out of order; but the restoration of the ordinary focus proved the haze to be the sole cause of the change. I can't explain optically why it was so; but it is a fact.

Mr. Penrose: I have found with a 30-inch telescope that the same focus is not available for the Sun and Venus. The Sun was viewed through a dark glass; but when I could dispense with this, and see the Sun through some cloud, the focus was the same as on the planet.

Capt. Noble: What colour had your sun-shade?

Mr. Penrose: I used grey, red, and green glasses. The focus was shorter with the dark glass on.

The President: I was recently talking to Mr. Claudet, the photographer, and he made the remark that at no two times during the day was the actinic focus the same. In morning, or afternoon, and at all times, there was a change. I also wish to ask Mr. Dawes whether the apex of the triangle has anything to do with the position of the eye?

Mr. Dawes: I never observed any difference, whether looking at the star direct, or with a prism which altered its direction; and the same when using a Newtonian reflector.

The Astronomer Royal: Has it a constant relation to the position of the eye?

The President: It has always a relation to the direction of the wind.

Mr. Dawes: Yes; it always appears with a NE. wind, but not invariably with the SE.

The President: It is more connected with the physiology of the telescope or the air than of the human frame.

Mr. Dawes: Yes; and I should like to ask Mr. Airy whether, if the triangular appearance arose from a disordered stomach, that could be cured by the peculiar shaped aperture I use?

The Astronomer Royal: It is certainly a very puzzling phenomenon.

The President: Has the triangle any relation to the earth?

Mr. Dawes: It is slightly raised towards the right. It never appears with a west wind.

The Astronomer Royal: Suppose you are looking with a Newtonian in the usual way—in at the side—has it any respect to the vertical or not?

Mr. Dawes: It varies with the direction of the telescope, and turns with elevation.

Mr. Stone: Can you give us any law for the direction of the vertex?

Mr. Dawes: I have not examined the point sufficiently. I always observe as near south as possible.

Mr. Stone: Then the vertex would be to the north?

Mr. Dawes: That is generally the vertical.

General Shortrede: With respect to shortening of focus on the Sun, I may mention that I use spectacles, but that in very strong light I can read without them. I expect a great quantity of light contracts the eye.

Mr. Penrose: That does not agree with my experience. Less light came through the grey glass than through the cloud.

The President: Mr. Dawes makes mention of a curious bulging out of star discs on a wire.

Mr. Dawes: Everyone sees that. As to the triangular form, Professor Struve said he saw it so often that he began to think the stars really were triangles.

The Astronomer Royal: Mr. Huggins has remarked that a considerable power is required to raise star discs. Now, I have had a very large number of telescopes sent me for trial in my time, and on fine nights have always put high powers on them. I am blessed with a fair stomach, and, except on the occasion I referred to, when the mind was disturbed, I never saw the distortion we are discussing. I have used powers of 800 and 1,000 on suitable telescopes, and never seen it. As to the point of different focus, and my idea that it arises from the difference between direct and skew vision, I would observe that I am very short-sighted, and wear strong spectacles; and when looking at distant lights, such as the Westminster clock, when I see things by direct vision, I am obliged to skew a little to see this.

Mr. Dawes: I am much obliged by the light you have thrown on the subject, which deserves careful examination.

Mr. Stone: Referring to No. 3 of Mr. Dawes' practical remarks, where he states that a triangular aperture produces six rays from the disc, which, he says, is hexagonal, but which Sir J. Herschel says is circular with a ring, I would ask, is he sure of this?

Mr. Dawes: When I found it out I wrote to Sir J. Herschel on the point, and he replied that he had no doubt I was right.

The President: And is the ring hexagonal?

The Astronomer Royal: All these matters are discussed in my papers on Optics. There would be a tendency to hexagonal rings, with breaks of interrupted light.

Mr. Stone: Herschel draws the disc and ring, with six rays from the ring.

The Astronomer Royal: The distortion is of a very complicated character, going off in six rays.

Mr. Browning: I should like to call attention to one point, as probably some discussion will arise out of it. Mr. Dawes has lately been writing in the *Astronomical Register** on the separating power of object-glasses, and stated that an objective of not less than 7¾ inches is necessary fairly to divide γ^2 Andromedæ. I then wrote a letter to the *Astronomical Register*,† referring to this statement, and saying that silvered glass mirrors of 6½ and 6¼ inches divided this pair. [Mr. B. read the letter *in extenso*.] I shall be glad to have any explanation of this; but the point of interest with me is—whether focal length, in relation to aperture, has anything to do with it? Mr. Dawes and Mr. Stone, both of whom are present, say division is a function of aperture only; but Mr. De la Rue, who is absent, thinks that focal length may be concerned.

A Member: A misty surface of the object-glass produces a smaller disc. I do not know whether this applies to reflectors.

The President: You mean that, there being less light, you see less of the disc?

The Member: I have heard this, but am not sure of it.

Mr. Dawes: In answer to Mr. Browning, I may say that the small metal of a reflector excludes the central light of the disc, and thus increases the dividing power precisely as a central patch upon an object-glass does.

Mr. Dallmeyer: What is the separation of γ^2 Andromedæ?

* No. 51, p. 50.

† [illegible]

The President: About 6–10ths of a second.

Mr. Dallmeyer: In all the calculations I have made, I find that 4·33 divided by the aperture gives the separating power. Thus 4·33 inches separates 1″.

Mr. Stone: Your data agree most closely with those of Mr. Dawes.

The Astronomer Royal: This is a critical point in optics.

The President: If this relation of aperture to dividing power be not true, the undulatory theory is upset. This is no proof of its truth, but it is as well to know the consequences.

Mr. Dawes: I don't know how silvered glass mirrors act as to the amount of light reflected, compared with that transmitted by refractors; but if the light be less, the discs will be smaller.

The Astronomer Royal: It is the diameter of the first ring, and not of the discs, which should be measured.

The President: After having passed his life in trying refractors, Mr. Dawes is now, if health be spared to him, about to investigate the properties of reflectors. Mr. Browning is going to furnish him with a 13-inch mirror, and I have no doubt Mr. Dawes will obtain most important results, and greatly enlarge our knowledge as to the merits of reflectors and refractors. If it turn out that reflectors equal or surpass achromatics of the same aperture, then good-bye to refractors.

Mr. Penrose: I went to buy a silvered glass reflector from Steinheil, but he dissuaded me from so doing, and got me to try one of his refractors.

The President: Mr. De la Rue had a 13-inch silvered mirror from Steinheil which did not equal his own, made of speculum metal, and he is now having one ground by Mr. With.

The discussion now terminated, and Mr. Alexander Herschel gave an oral account of *Some results as to the height of the November meteors*. It appears that eye observations of these meteors have been recorded since 902 down to 1833, as many as 13 of their recurrences having been noticed, from which a period of about one-third of a century has been deduced, and this characteristic cycle enabled us to predict the shower of November 1866. As the first known display was on the morning of the 18th October 902, N.S., and the last on the morning of November 14th, 1866, the date of the shower has progressed 27 days in 29 recurrences, or nearly a day each time. Thus the dates are 12th November 1799, 13th November 1833, and 14th November 1866, proving the astronomical character of the display beyond a doubt, and that they are a stream of bodies revolving round the Sun. We may expect the shower again next November, but it will be a little later. The Earth arrives at the same longitude about 6h. 48m. on the morning of the 14th; but other causes render the shower more likely at 7h. 30m.—just at daybreak here—so that we may not see it well, as there will be a moon shining, but in America it is anticipated there may be a fine view. At the last display, one of the brightest meteors occurred at the latter part of the shower, about 2h. 45m., and left a remarkable luminous streak, which was seen at Glasgow in Ursa Major. The meteor itself was not observed, but the singular convoluted track of light remained visible for a considerable time. Other observations were made on the same meteor. At Aberdeen, Mr. D. Gill, assistant in the observatory, traced the luminous track from Pollux to Aldebaran, and after the meteor's disappearance the train changed its form and encircled the Pleiades. If we draw lines in these directions from Glasgow and Aberdeen we shall find they intersect at 51 miles above the town of Dundee. Another account was received from Mr. Backhouse, at Sunderland, who missed seeing the meteor, but saw its train at 2h. 42m. half-way between *α* Cephei and *α* Cygni. In two minutes it changed its form and remained visible for twenty minutes, but was low in the mist. This is worthy to be compared with the other observations, and the lines of sight meet at 57 miles above Dundee, giving a similar independent value for the height. Professor Piazzi Smyth, who describes the star shower, says there must have been a fine meteor at 2h. 41m., as he saw a streak of light between *α* Ursa Majoris and *α* Ursa Minoris. This is rather wide; but if we take the position as before determined, we find it would be projected on the sky at Edinburgh midway between those two stars. Another confirmation is derived from the place given by Mr. Barkas at Newcastle. This is the only case recorded which admits of comparison for distance, and it is rather surprising that with such a number no more cases have occurred for discussion.

The general character of the November meteors appears to be that they are planetary bodies passing through the higher regions of our atmosphere, and producing light and heat from their impact; but how is a mystery, and the spectroscope has at present given no definite results identifying the light with any earthly flames—unlike the August meteors, which differ entirely from the November ones by presenting a definite yellow line, sometimes mixed with a diffused spectrum, and sometimes resulting from the fading of the diffused spectrum. This is the line due to Sodium. What the November meteors contain we shall perhaps learn from the use of the spectroscope and telescope another time. It is difficult to understand why the former was not applied at Glasgow on such a persistent streak as the one described. Mr. Herschel's remarks were illustrated by drawings of the appearance and course of the meteor referred to.

The following paper was read by the author :—

Notes on some Drawings of "Mars," made during the recent opposition : by Mr. John Browning.

The thirteen coloured drawings of Mars now exhibited* to the Society were made with Mr. Barnes' 8½-inch silvered-glass reflector. They represent the planet as it appeared at various times between December 29th, 1866, and February 24th, 1867.

These drawings have been shown to Mr. De la Rue, who had no trouble in matching two of them with his own two exquisite drawings of the planet. Mr. De la Rue's drawings, which were taken by the aid of his 13-inch metal speculum, of his own make, contain more detail; but Mr. De la Rue expressed his opinion that Mr. Browning's drawings were valuable from the number obtained.

The author made nearly thirty sketches at the telescope, but copied only those that were made when the air was tolerably steady, and the definition so good that he could work well with high powers.

When several sketches were made on the same evening, they were made at intervals of two hours if the weather permitted. In only one instance he failed to perceive that the form of the markings was permanent, due allowance being made for the effect of perspective in foreshortening them as they approached the edge of the disc.

It is highly probable that, in the view of the planet taken on February 16th at 6.45, the two pointed markings on the extreme left, one above and the other below the equator, would have been seen united if they could have been observed when they were on the centre of the disc. This drawing would then have agreed pretty closely with one of Mr. Dawes' views, engraved in the *Astronomical Register* for September 1865.

The colour of the body of Mars was found to vary from rose-madder to burnt-ochre, the colour appearing ruddiest when there was most mist in our atmosphere. The comparative absence of the ruddy colour towards the edges of the disc of the planet, Mr. Norman Lockyer has ascribed to the presence of clouds in the planet's own atmosphere.

Mr. Huggins, in his paper on the spectrum and the colour of Mars,† has referred the absence of colour at the edges of the planet to some peculiar effect of the surface of the planet itself.

That the ochreish colour is due to some peculiarity in the surface is almost proved by Mr. De la Rue's drawings of Mars, as in these are seen markings of an ochreish colour with definite outlines.

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* Six very large drawings were also displayed on the walls.

† *Ast. Reg.* No. 52, p. 79.

The colour of the dark markings has been described as greenish or blueish-grey. They always appear blueish-grey to Mr. Browning, and this colour he has depicted them. Occasionally the North polar ice has been shown tinted with the same colour.

He examined the spectrum of the planet with a direct vision spectroscope. The spectrum of the dark markings presented no distinctive peculiarity. This would surely prove the entire absence of a blue or green shade of colour in the markings, as it has been found that if white light be reflected five or six times from surfaces of metallic silver and then received on white paper it will be strongly tinged with a chocolate colour. Yet if the light reflected from paper thus illuminated be examined by means of a spectroscope, no appreciable difference will be seen between the spectrum of this light and that of white light. In consequence of the effect of irradiation, the outline of the North polar ice could not be satisfactorily made out.

Faint white spots were frequently seen to appear on the disc, and as these spots approached the edge of the disc they increased in brilliancy until, when nearly at the extreme edge of the disc, they almost rivalled the polar snows in whiteness. The white cloudy patches had never any definite outlines. They were generally nearly circular in form, and they always appeared in the region of the equator.

One of these white cloudy spots is shown in the sketch taken on February 8th, at 10.30. The spot is represented passing off the left-hand edge of the disc. Mr. De la Rue has shown the dark markings near the South pole as darkest towards the edge nearest to the centre of the planet, and just below the edge of the dark markings the ruddy colour of the body is much fainter than it is nearer to the equator.

Mr. Browning saw these appearances distinctly.

In the drawing taken on January 28th, at 9h., a number of breaks will be seen at the edge of the dark marking near the South pole, these breaks forming a series of light streaks towards the pole. Mr. Barnes made a sketch at the telescope without seeing Mr. Browning's; and as, with the exception of a slight difference in the angle given to these light streaks, the two sketches agreed, there can be no doubt of their truth.

On the 31st of March, at 7 P.M., an exact repetition of Mars, and in the position shown in the sketch taken on February 23rd, at 9 P.M., was obtained.

This includes 35 rotations, and would give a velocity of revolution to the planet agreeing within 44 seconds with Beer and Mädler's determination.

In these two drawings, the mark usually termed the hour-glass mark is represented as having just passed the centre of the disc of the planet.

Mr. Barnes has made sketches corresponding with nearly all these drawings, and agreeing with them in all the general features.

Mr. Browning added that it would be found that while his drawings agree admirably with Mr. De la Rue's and tolerably with those of Mr. Dawes, they have but little resemblance to Father Secchi's, and none at all with Beer and Mädler's.

The President: This is a remarkable case of professional pursuits and recreation taking the same direction. Except Fraunhofer, I hardly remember a person whose business it was to make instruments, employing them for observation as his amusement.

Mr. Stone: Has Mr. Dawes measured the ellipticity of Mars?

Mr. Dawes: I have measured it carefully, and find no difference whatever.

Mr. Browning: I have tried to measure it with a cobweb micrometer, but can detect no ellipticity.

The meeting then adjourned.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

THE NAUTICAL ALMANAC.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I have to acknowledge an error in a letter of mine which appeared in a recent number. I there remarked that "the column of horizontal parallaxes appeared to be drawn up with little care in our otherwise all but perfect Astronomical Ephemeris;" subsequently, in support of this view, I gave a list of numbers, derived, as I supposed, from the Nautical Almanac. They were extracted from Dietrichsen and Hannay's Almanac, the astronomical information in which is known to be taken from the Nautical Almanac. I find, however, that the compiler of this part of D. and H.'s Almanac had, for unknown reasons, gone out of his way to introduce matter not thought necessary for the Nautical Almanac; and that in some inexplicable manner he had arrived at the series of erroneous values I referred to. As an excuse for my having quoted these numbers without actually referring to the Nautical Almanac for 1866 (of which I had no copy by me), I may point out the utter *à priori* improbability (1), that the compiler of the smaller Almanac should try to improve on the larger one; or (2), supposing this, that so super-accurate a person should not be able to calculate the elements he required—all of which could have been correctly determined by any one acquainted with the elements of mathematics in about a quarter of an hour. It appeared far more probable to me (or rather, I never for a moment doubted) that this column, which for certain dates has no practical value, had been left to some junior calculator of the Nautical Almanac office, and the work of calculation somewhat perfunctorily effected.

I have to thank Mr. Lynn for pointing out the mistake I had made, and thus affording me the opportunity of correcting it.

Believe me, Sir, yours faithfully,

Woolwich: May 12, 1867. RICH. A. PROCTOR.

THE "HARVEST" AND THE "HUNTER'S" MOON.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Some time ago questions were asked in your journal concerning the "Harvest Moon" and "Hunter's Moon," and the replies given were, I believe, all to the effect that the Harvest Moon is the full moon occurring next before, and the Hunter's Moon that occurring next after, the time of autumnal equinox.

I believe at the time that I had somewhere seen a statement at variance with this—giving, in fact, the Harvest Moon to the full moon occurring nearest to the time of autumnal equinox, and the Hunter's Moon to that occurring nearest to the time of vernal equinox. The thing is of no great importance; but having lately chanced to light on such a statement, a reference to it may interest some of your readers.

In Knight's "Companion to the Almanac" for 1828, there is a paper (author's name not given) on the "Celestial Phenomena of the Year." The writer says: "Two other peculiarities of the moon that occasion a good deal of speculation among those who are ignorant of the causes, are 'the Harvest moon' in September, and 'the Hunter's moon' in March; the former of which, when near the full, rises for several nights at nearly the same hour, and the latter, at the same age, is equally remarkable for the difference between the times of its rising." The writer goes on to explain the cause of these phenomena; but, as it is well known to your readers, it is not necessary to make further extract. Arago also distinctly calls the hunter's moon "that full moon which occurs when the sun is near the *spring equinox*" ("Astronomie Populaire," vol. iii., p. 533).

Your obedient servant,

Greenwich: May 11, 1867. W. E.

METEORS AND COMETS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The meteoric shower of April 20 was not seen in this neighbourhood, owing to the cloudiness of the night at that time. I was much disappointed.

The other showers (besides the August and November ones, the importance of which all are now alive to), to which our attention is called by the elaborate and interesting paper of Dr. Weiss, my translation of which you printed in the last number of the *Register*, are, I think, those of January and October. Of the former I wish to say a few words.

In the year 1865, Mr. (now Professor) A. S. Herschel observed, on the night of January 1, a considerable number of meteors of the apparent size of stars of the second and third magnitude, and one equal to Jupiter. Of 1866 I have not seen any account, as the British Association Report is not yet published. But Mr. Birmingham, of Millbrook, Tuam, Ireland (the discoverer of [T] Coronæ) writes me that on the night of January 2 last, 1867, he observed a number of very fine ones, and that "they had a decided radiant between η, ζ, and the head of the Dragon."

You will have remarked that Dr. Weiss calculated that on January 3 the Earth passes through the plane of the orbit of Comet II. 1792, very near its descending node; our distance from the comet's orbit being only 0·073 of the Sun's distance, and that the next day we are three times nearer than that (little more than two millions of miles) to Comet IV. 1860, in its ascending node.

That comet was discovered by Tempel, at Marseilles, in 1860, October 23. His description of it was that it was of the diameter from 3 to 4 minutes; the light not uniform, but scattered like a small cluster of very delicate stars, insomuch that he was for some time doubtful whether it was really a comet. It was an extremely faint comet, and very imperfectly observed. The inclination to the ecliptic, according to the last calculations of M. Valz, was about 28°. It is curious that of Comet I. 1866, Tempel, who discovered it (in 1865, Dec. 20), remarked that it also resembled a small delicate star-cluster, "perhaps made visible by its uncommonly quick motion."

I remain, Sir, yours faithfully,

Greenwich: May 14, 1867. W. T. LYNN.

METEORIC GAS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Some remarks were made last night, at the Royal Institution, by Professor Odling, in a lecture on the Absorption of Gases by Metals, which I think will interest all your readers, however bare my recital of them may be.

Chemists have found that certain metals have great power of absorbing into them divers gases in a very high condition of pressure. These gases appear *kneaded* into the metallic atomic interstices, if such an expression may be used, and can be expelled therefrom by suitable means. The metals especially sympathising with gases, in this way, are Platinum and Palladium.

Iron entertains similar sentiments in a less degree, and associates with itself chiefly hydrogen. Some native specimens of *meteoric* iron having been subjected to the necessary treatment, yielded up a volume of gas substantially identical in composition with the gas habitually yielded up by terrestrial iron; whence the lecturer concluded that whatever part of the universe the meteoric iron may have come from, there is a substantial unity of at least chemical character, in the cosmos, hydrogen gas existing beyond the limits of the earth's surface and atmospheric envelope.

Your obedient servant,

Junior Carlton Club: GEORGE F. CHAMBERS.
May 18, 1867.

GAMMA VIRGINIS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—With your permission, I should be very much obliged if one of your correspondents would supply a novice with a reliable recent measure of Gamma Virginis. On the 27th ultimo, I made my first complete double-star measurement, by attempting this celebrated star, though, from its small distance, I apprehend it is rather a trying one for a beginner. These are my results with a position wire micrometer by Simms, attached to a small but completely mounted equatorial by the same maker, of 4-inch aperture, the Position with a power of 75, and the Distance with that of 102, the real powers being, however, about doubled by the interposition of a "Barlow lens."

Position	Obs.	Dist.	Obs.	Epoch
163°·5	10	4″·64	7	1867·32

The distances are double measures, taken on each side of one wire left fixed at zero.

I am the more induced to give this measure (with your permission), as one of the appendices to the *Speculum Hartwellianum* contains a predicted orbit for some years in advance, founded on calculations made by one of the sons of the late lamented Admiral, Captain Henry Augustus Smyth; and one of the epochs is for almost the identical date on which the above attempt was made, and as there is a very close agreement between the two, Captain Smyth's prediction is here given. (*Spec. Hartwell.* p. 452.)

Pos.	Dist.	Epoch
163°·5	4″·708	1867·34

Looking at the general run of recent measures, as given in Mr. Brothers' most useful catalogue of binary stars, I am inclined to think my distance is too great; indeed, I should not have troubled you with this crude attempt, were I not anxious to call attention to this prediction, and I am looking forward with great interest to the confirmation or otherwise of Captain Smyth's calculated position and distance.

In conclusion, I should like to take this opportunity of making an inquiry. Who is the "poetaster," the "rhymester," the "brackish poet," the "galley-poet," the "salt-water poet," whose "brackish-rhymes," "galley-rhymes," galley-stave heroics, directions for finding the constellations, are so copiously quoted in the second volume of the *Celestial Cycle*? Is the author the late worthy Admiral himself? Do not the following words, from the note, vol. i., p. 435, rather lead to the inference that he is the author? "If the *memorial* verses are found deficient in attic salt, they may lay claim to being brackish."

I am, Sir, yours obediently,

Edgbaston: May 7th, 1867. GEORGE HUNT.

DIAPHRAGMS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The use of diaphragms for cutting off the marginal parts of the apertures of telescopes is more commonly necessary with reflectors of considerable aperture than refractors. To the former they are more or less indispensable for moderating the light, or removing the false glare which usually surrounds the discs of large fixed stars. A very valuable contrivance was some time ago applied to refractors for this purpose, by Mr. Alfred Brothers. of Manchester. An elastic band of india-rubber is attached by its outer edge to a couple of brass rims, one of which is fastened to the tube and the other left free to revolve over 180°, in doing which the free edge of the elastic is wrinkled and expanded so as gradually to cover up the object-glass, the orifice of the elastic continuing central and circular to the last. As this form of diaphragm is applied at the opposite end of the tube to where the observer is stationed, it is necessary to have some mechanical connection by which the brass rim may be made to revolve, and the means of knowing the precise aperture employed.

The object of this communication, however, is to explain another mode of applying the diaphragm, which is applicable to reflectors and refractors alike, whatever may be their apertures.

Instead of placing a large diaphragm to intercept the light before reflection, I use a much smaller one, which does it afterwards. In order to this, I had two narrow slits sawn on either side of the short tube which carries the adapter and eye-piece of my reflector, and a strip of brass plate an inch and a half wide made to pass through smoothly. On this plate is a row of holes or diaphragms, carefully graduated, and numbered to represent apertures at the mouth of the tube from five to twelve inches respectively. A spring is inserted within the tube, to receive notches along the edge of the brass plate, which as they pass indicate that the diaphragm in use is precisely central with the opening. The success of this contrivance is quite perfect, and the convenience of it much greater than any other plan that I have yet tried. I find it necessary, in order that the darkening of the field of view may be equalised, that the diaphragm slide should be inserted as far as may be convenient for this purpose from the eye-piece—8 or 10 inches will be found sufficient.

If this mode of applying diaphragms should prove on experiment to answer well for refractors, the slide containing them could be immediately within reach of the observer, instead of his apparatus being placed at the other end of the telescope.

Diaphragm slides also might be provided, for experimental purposes, containing central stops and openings of various forms and sizes, as might be thought necessary for determination of magnitudes, and the more perfect definition or separation of celestial objects.

I am, Sir, yours faithfully,

Birmingham: May 14, 1867. F. BIRD.

THE PUBLICATIONS OF THE ROYAL ASTRONOMICAL SOCIETY.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Knowing that the *Astronomical Register* circulates largely among my brother Fellows of the Royal Astronomical Society, I am anxious to call their serious attention to the return which we obtain, in a literary point of view, for our entrance fee and annual subscription. We pay, as is well known, an entrance fee of three guineas, and an annual subscription of two. Now, what do we get for this? Imprimis, the privilege of attending the meetings. This is undoubtedly of value to those Fellows resident in or near London; but of what earthly use is it to those who live one or two hundred miles from the metropolis? Practically, they are debarred entirely from availing themselves of it. Secondo, we get the "Monthly Notices"—"et præterea nihil." It is more especially with reference to this that I would wish to speak. The annual volume is made up of nine numbers; and these, considering that not a farthing is paid for authorship, we may reasonably value at the same number of shillings. This, then, is the equivalent which a large proportion of us have for our subscription. Do we, or do we not, get our money's worth for our money? We pay our editor sixty pounds a year, as it seems to me, for doing in a most dilatory and perfunctory manner what we should get much better executed by any professional literary man for a third of the money. Literally, all Mr. Cayley has to do is to collect the papers read at the meetings, and see (which he systematically does *not*) that the number containing them is issued in proper time. I know that I shall be told that Mr. Cayley is a most eminent mathematician, and a man whom we ought to consider ourselves honoured by having for an editor at all. I have heard language like this employed on a similar occasion before now, but it is simply irrelevant. Do we get sixty pounds' worth of his eminence in the "Monthly Notices?" Sixty shillings' worth? Nay, do we get sixty pennyworth? Does he even annotate a single paper, or do more than reprint it as it reaches him from the author? And, if this be the case, of what conceivable use is his eminence to us, who merely want an efficient editor? However, the "Monthly Notices" (well, badly, or indifferently edited) we do get—and nothing else. Our "Memoirs" we are compelled to buy; and this is the point to which I would earnestly call the attention of my brother Fellows. Our Council is liberal enough when there is any "eminence" to be rewarded; if observations are to be reduced; if two medals are to be given, in defiance of our bye-laws—*et id genus omne*; but to us, mediocrities, the mere ordinary Fellows of the Society, this liberality is by no means to be extended. Our Transactions are sown broadcast in the way of gifts to outsiders; but we, with whose money they are produced, have to pay for them twice over if we require them. And, apropos of this, I should like to ask any member of the Council of the Royal Astronomical Society who may read this, whether he as an individual, or the Council as a body, is aware that the sets of our "Transactions" presented to an individual, whom I may periphrase as a distinguished scientific person, are disposed of by that person to a second-hand bookseller, and advertised by him for sale to the general public? And, further, assuming that such a fact were substantiated to the satisfaction of the Council, whether they would feel justified in continuing to supply the person referred to with books (which they withhold from the paying Fellows of the Society) for such a discreditable purpose? It was my intention to have given a detailed list of the publications of other learned societies—to have shown how the Fellows of the Royal Society obtain for their 4*l.* the 4to. "Philosophical Transactions," with its 800 or 900 pages, and 30 plates, and the "Proceedings" with its 500 pages—how the Fellows of the Linnæan Society get their "Transactions," of 400 pages, with 40 plates, in 4to., and their "Journal" of 400 pages and 20 plates in 8vo., for their annual 3*l.*—how the Fellows of the Microscopical Society actually receive 16*s.* worth of "The Microscopical Journal" in return for their guinea a year—how the Geological Society issues its "Quarterly Journal," and so on. But to do so at length would only fill up your columns unnecessarily, and could scarcely strengthen much more the assertion which I unhesitatingly make, that if the object of any one can conceivably be to join a scientific body in which the maximum of subscription is combined with the minimum of return for it, he had better at once become

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

May 8, 1867.

VARIABILITY OF a CASSIOPEIÆ.

Results of Observations in 1867, between February 1 and March 29.

By W. R. Birt, Esq.

Epochs of greater brilliancy, about the brightness of β.						Epochs of inferior brightness, less than β.					
1867	d.	h.	m.	Mag.	Interval days	1867	d.	h.	m.	Mag.	Interval days
Feb.	4	11	0	2·60	—	Feb.	2	10	30	2 82	—
,,	14	8	0	2·63	9·875	,,	6	10	0	2·72	3·98
,,	28	10	0	2·62	14·08	,,	23	7	0	2·74	16·875
Mar.	2	8	15	2·63	1·93	Mar.	25	10	0	2·79	30·125

	Minimum				Interval		Maximum			
	d.	h.	m.	m.	d.		d.	h.	m.	m.
Feb.	2	10	30	2 82	25·98	Feb.	28	10	0	2·62
	Maximum						Minimum			
	d.	h.	m.	m.			d.	h.	m.	m.
Feb.	28	10	0	2·62	25·00	Mar.	25	10	0	2·79

Interval between the Minima . . . . . 50·98 days.

The star appears to retain its character of *irregularity* of variability. Upon projecting the light curve, it is seen that while there is an upward progression more or less regular from the minimum (?) of February 2 to the maximum of February 28, and as regular a downward progression to the minimum of March 25, the curve is irregularly inflected—judging from the few observed points—especially in those portions where observations were most frequent, a feature often noticed in my observations of 1859. The almost sudden alternations of brightness—by no means a rare phenomenon in 1859—have been occasionally observed. α has only on one evening exceeded β in lustre, and that but for a short time. When near the maximum it did not exceed β, but was registered as being equal to it: at the same time β was suspected of exhibiting rather more than its usual brightness. A similar suspicion is mentioned in my paper, vol. xx. p. 40 of the Monthly Notices of the Royal Astronomical Society, December 1859.

During the period between the minima of February 2 and March 25, the star has not attained to the brightness of γ; the range is accordingly less than in 1859 by about 0·11 magnitude.

The magnitudes used for the comparison of α with β and γ are those of Sir John Herschel, appended to his Cape Observations—viz., γ 2·52, β 2·63. Sir John determined the magnitude of α to be 2·57, i.e. between the two.

The following are the recorded magnitudes of β and γ:—

	β	γ
Argelander	2·2	2·3
Greenwich Catalogues (Argelander) . .	2·3	2·0
Astronomical Society's Catalogue . . .	2·3	3·0
British Association Catalogue . . .	2·5	3·0
Sir John Herschel (Cape Observations). .	2·63	2·52
Radcliffe Catalogue	2·9	2·8

The want of accordance in these determinations is curious. Especially the greater differences in the magnitudes of γ, amounting to a whole magnitude. Argelander, Sir John Herschel, and the Radcliffe observers agree best in the difference of lustre between β and γ, viz. 0·1 magnitude; but the order of brightness is reversed, Sir John Herschel and the Radcliffe observers making γ the brightest, and Argelander β. The values given to β and γ by the Radcliffe observers are very low. The British Association Catalogue gives γ as half a magnitude *below* β. Do these differences point to variability in both stars?

The remarkable phenomena recognised by means of the spectrum of γ is not without interest in connection with the above determinations of magnitude. The authority for γ having been seen as a third magnitude star would be valuable. I have often thought, both in 1859 and at present, that γ is nearer a second magnitude. Generally, I see it brighter, sometimes much brighter than β, and usually at a steady brightness. I have a strong suspicion that β varies slightly. Has γ been gradually getting brighter, but so slowly as to have escaped notice? The low estimates of the Radcliffe observers may probably depend on the *scale* adopted.

My estimates of the lustre of α depend upon those of the stars γ and β, and if γ be now really brighter than determined by Sir John Herschel at the Cape, they are all too low; *relatively*, however, to γ and β, they may mostly be depended upon. If β slightly varies, its variability is mixed up with that of α, which in 1859 did not exceed 0·3 magnitude.

ASTRONOMICAL OCCURRENCES FOR JUNE 1867.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Sat	1		Sidereal Time at Mean Noon, 4 38 0 3			Saturn — 10 30·4
Sun	2	3 12 6 5	● New Moon Conjunction of Moon and Mercury, 5° 58′ N.	2nd Tr. E.	15 17	10 26·2
Mon	3	19 46	Conjunction of Moon and Uranus, 5° 5′ N.	3rd Sh. E. 1st Ec. D.	15 24 15 46 0	10 22·0
Tues	4		Meridian passage of the Sun, 2m. 2s. before Mean Noon	1st Sh. I. " Tr. I. " Sh. E.	13 4 14 26 15 24	10 17·8
Wed	5			1st Oc. R.	13 54	10 13·6
Thur	6	22 24	Conjunction of Moon and Mars, 3° 48′ N.			10 9·4
Fri	7			4th Oc. R.	14 15	Moon. — 4 50·2
Sat	8	18 37	☽ Moon's First Quarter			5 41·3
Sun	9	0 0	Moon's libration—greatest portion of the N W. quadrant visible	2nd Sh. I. " Tr. I. " Sh. E.	12 15 14 57 15 10	6 29·6
Mon	10			3rd Sh. I.	15 42	7 16·1
Tues	11			2nd Oc. R. 1st Sh. I.	12 53 14 58	8 1·5
Wed	12			1st Ec. D.	12 8 22	8 46·6
Thur	13	12 36 13 40	Conjunction of Uranus and Mercury, 1° 40′ N. Conjunction of Moon and Saturn, 2° 0′ S.	1st Tr. E.	13 5	9 31·9
Fri	14	12 32 13 36	Occultation of 49 Libræ (5½) Reappearance of ditto	3rd Oc. R.	14 29	10 17·8
Sat	15	7 7 7 41	Occultation of B A.C. 5579 (5) Reappearance of ditto	4th Sh. E.	12 19	11 4·3

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Saturn —
Sun	16	 16 54	Sidereal Time at Mean Noon, 5 37 8·6 ○ Full Moon	**2nd** Sh. I.	14 51	9 27·8
Mon	17		Declination of Saturn $-15^\circ\ 1'\ 38''$			9 23·6
Tues	18	13 53	Near approach of Moon to ρ^2 Sagittarii (5½)	**2nd** Oc. R.	15 22	9 19·5
Wed	19		Meridian passage of the Sun, 0m. 55s. after Mean Noon	**1st** Ec. D.	14 2 21	9 15·4
Thur	20			**1st** Sh. I. „ Tr. E. „ Sh. E.	12 37 13 40 14 56	9 11·2
Fri	21	12 51	Conjunction of Mars and Regulus, 8m.·2 W.	**1st** Oc. R. **3rd** Ec. D. „ Oc. D.	12 5 13 5 8 14 39	9 7·1
Sat	22	18 25	Conjunction of Moon and Jupiter, 2° 1′ S.			9 3·0
Sun	23			**4th** Ec. D.	15 2 13	8 58·9
Mon	24	17 28 23 0	☾ Moon's Last Quarter Moon's libration—greatest portion of the NE. quadrant visible			8 54·8
Tues	25			**2nd** Ec. D.	12 32 10	8 50·7
Wed	26					8 46·6
Thur	27			**2nd** Tr. E. **1st** Sh. I. „ Tr. I. „ Sh. E.	12 3 13 14 14 26 15 33	8 42·5
Fri	28			**3rd** Ec. D. **1st** Oc. R.	13 33 14 13 54	8 38·4
Sat	29	17 50	Conjunction of Moon and Venus, 4° 9′ N.	**1st** Tr. E.	11 13	8 34·4
Sun	30	11 45	Conjunction of Uranus with the Sun			8 30·3
JULY Mon	1					8 26·2

THE PLANETS FOR JUNE.

Mercury will be well situated for observation during the latter half of June, having a great northern declination; during the last ten days the planet sets about an hour and a half after the Sun.

		h.	m.	s.			°	′		
1st	R.A.	4	38	47	Decl.	+	22	54	Diameter	5″·0
15th	„	6	45	29	„		25	3½	„	5″·6

Venus continues to be a morning star, and passes the meridian at about five minutes to ten A.M. at the beginning, and about half an hour later at the end of the month.

1st	R.A.	2	32	35	Decl.	+	13	9	Diameter	12″·0
15th	„	3	39	19	„		18	3½	„	11″·4

Illuminated portion of the disc of Venus, 0·885.

Mars may be observed in the evenings, setting about midnight at the beginning, and about an hour earlier at the end of the month.

1st	R.A.	9	25	12	Decl.	+	16	42	Diameter	6″·4
15th	„	9	55	18	„		13	59	„	6″·0

Illuminated portion of the disc of Mars, 0·919.

Jupiter rises shortly before one o'clock in the morning at the beginning of June, and about two hours earlier at the end of the month. The planet remains about ten degrees south of the equator.

1st	R.A.	22	34	31	Decl.	—	10	2	Diameter	41″·6
15th	„	22	37	40	„		9	47½	„	43″·0

Saturn continues well placed for observation, although at a low altitude, and is visible most part of the night.

1st	R.A.	15	10	12	Decl.	—	15	15	Diameter	18″·0
15th	„	15	6	46	„		15	3	„	17″·8

Dimensions of Ring—Outer Major Axis, 41″·5; Outer Minor Axis, 15″·5.

INSTRUMENTS, &c. FOR SALE.

These Notices, which are restricted to *two lines* each, are inserted free of charge to subscribers: applications respecting prices and other particulars to be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—For Advertisements with prices and more complete details, a small charge will be made.

N.B.—It is particularly requested that we may be informed when instruments are disposed of, in order that the notice may be withdrawn, and fruitless applications prevented.

Achromatic Refractor, 6·4 in. ap. 8½ ft. focus, by *Merz,* Equatorial and clockwork by *Troughton & Simms.* [73]

Achromatic Refractor, 4 in. aperture, by *Cooke & Sons*; equatorially mounted, complete in every respect. [104]

Achromatic Refractor, 4 in. ap. 5 ft. focus, by *Dollond*; equatorially mounted. Powers up to 400. [87]

Gregorian Reflector, 4¾ in. ap. 2 ft. focus, by *Dollond,* 4 powers, 50 to 200, finder, &c., on brass table stand. [63]

Achromatic Object-Glass, 4⅛ in. ap. 62 in. focus, by *Slugg,* with brass cap and receiving cell, for mounting on tube. [85]

Silvered Glass Speculum, 10½ in. diameter, 7 ft. focal length, of excellent quality, by *Mr. With*, in wooden tube; price moderate. [101]

Transit Instrument, 3¾ in. ap. 5 ft. focus, Ys fitted with agates for mounting on stone piers. [29]

Two Equatorial Stands, for 5 ft. telescope: with circles, &c. complete. [99]

Equatorial Stand, for a 5 or 6 ft. telescope: 13 in. circles, divided on silver, to 10″ of space and 4s. of time.—Has never been used. [55]

Transit Instrument, ap. 2½ inches, by *Jones*, Charing Cross: with three circles, divided on silver. [98]

Polar Axis, of mahogany, 7 ft. long, adapted for a 4 ft. telescope, with 12 in. circles, reading to minutes. [56]

Speculum Grinding Apparatus, capable of working a 7 ft. speculum: with tube and fittings for a 9 in. Newtonian. [57]

Observatory, Wooden, remarkably well constructed, 10 ft. sq. [103]

Recreative Science: and the first three volumes of the **Photographic Journal:** price very low. [30]

INSTRUMENTS, &c. WANTED.

Astronomical Clock, not very first-class; price low. [65]

Equatorial Stand, for a 5 ft. Refractor: graduated circles. [35]

Brass Tripod for a 2 ft. Telescope: condition not material. [106]

Transit Instrument, 2 in. ap. 18 or 24 in. focus. [71]

Transit Instrument, 1½ in. aperture, about 20 in. focus. [102]

Monthly Notices of the Royal Astronomical Society, Vol. 3. [26]

Monthly Notices: Vol. 5, No. 12. [82]

Bartholomew Prescot on the Universe, published 1823: a copy wanted, in good condition. [84]

Galbraith's Mathematical and Astronomical Tables, 2nd edition. A good price will be given for a clean copy. [105]

BRIEF CORRESPONDENCE.

SOLAR ECLIPSE.—If *Curiosus* can obtain no better reply, he will find on referring to Guillemin's work, *The Heavens*, p. 175, that there will be no total eclipse of the sun visible *in London* during the present century. The eclipse of the 19th August 1887, it is there stated, will be total in the north-east of Germany, the south of Russia, and Central Asia. I suppose it may hence be inferred that it will not be total in any part of Great Britain. G. J. W.

THE NAUTICAL ALMANAC.—May I be allowed to notice in your pages a rather singular mistake in the *Nautical Almanac* for 1867, p. 486, in which the opposition of Saturn is stated to be on April 29th, at 7h. 49m., instead of May 11th, at 12h. 27m. E. B. K.

[In our copy of the *Nautical Almanac* for 1867, the opposition of Saturn is noted on p. 487, May 11, 12h. 27m.—ED.]

THE SATELLITES OF SATURN.—The real reason why eight satellites do not appear in the engraving on p. 142 of my *Descriptive Astronomy*, is not that given by "D. T. K.," but because the said illustration is from an old sketch bearing date prior to the discovery of Hyperion. It is, however, a fair matter for consideration that the block should be amended.

G. F. CHAMBERS.

GLASS SPECULA.—Perhaps one of the readers of the *Register* will inform me if Mr. With's short focus glass specula can be mounted in Herschelian telescopes without much distortion to the image?

M. W. B. C.

THE PYRAMIDS.—Can any one inform me of any review, tolerably detailed, of Professor Piazzi Smyth's recent work on the Pyramids? Perhaps some notice of it, so far as it bears on astronomy, will be given in the *Astronomical Register*.

G. J. W.

DIAMETERS OF THE PLANETS.—Can you explain the variation which appears between the semi-diameters of the planets (especially Jupiter and Saturn), at pages 301 and 302 of the *Nautical Almanac* for this year, and the semi-diameters as given in the Ephemeris for Transit in the same volume?

Q.

Astronomy and Scripture. By the Rev. T. Milner, M.A. London: J. Snow.

It is well to endeavour to develope or create a taste for astronomy in young persons: a book may be the means of awakening an interest afterwards productive of great utility. The above pleasingly written little book may be remembered among works calculated to interest the young: it was published in 1843, and is therefore not up to the present state of the science, but this does not affect the general object of the work.

LIST OF SUBSCRIBERS—Name received since our last number.

Lassell, W., Esq., Ray Lodge, Maidenhead.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To March 1867.

Harris, Rev. C. S.

To June 1867.

Metcalf, Rev. W. R.
Oldfield, W.

To September 1867.

Lassell, W.
Locke, W.

To December 1867.

Barber, J. T.
D'Alquen, F. M.
Gould, Rev. J. R.

NOTICES TO CORRESPONDENTS.

Correspondents communicating with the Editor are particularly requested to notice the change in the address to Parnham House, Pembury Road, Clapton, N.E., instead of Stamford Villa, as heretofore.

Numerous communications are unavoidably delayed.

J. C. wishes us to put ourselves into communication with the scientific journals in other countries—France, Germany, Russia, Italy, North and South America, Japan, China, and India—so that each should reciprocally publish in their several journals the translated copies of the leading articles, official reports, &c. of the scientific societies of each country; a staff of translators to be appointed by mutual payment in Egypt as a central station, the most appropriate for communication with all the world for the promotion of Astronomy; photographs of eclipses, comets, &c., to be taken in each of the countries, engravings of which might appear in the *Register* or other publications. The whole, J.C. thinks, would greatly increase the circulation of the *Register*, enable it to be enlarged in size, to give more illustrations, and to be sold at a lower price. One thing, however, is lost sight of—the large amount of capital required to set so utopian a scheme into operation; to arrange its details even would involve an amount of labour and thought which the circulation obtained by scientific journals in the present day would never repay.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 55. JULY. 1867.

ROYAL ASTRONOMICAL SOCIETY.

Eighth Meeting, June 14, 1867.

The Rev. C. Pritchard, M.A., F.R.S., *President*, in the Chair.

Secretaries—Mr. Stone and Mr. Huggins.

The minutes of the last meeting were read and confirmed.

Thirty presents were announced, and the thanks of the Society given to the respective donors. The books included a volume of Ephemerides, extending from 1482 to 1506, by Regiomontanus, presented by Mr. Dawes, and an Ancient Treatise on Astronomy, by Alfregenius, purchased with the Turnor Fund.

Edward Crossley, Esq., Henry Wood, Esq., and
Charles Judd, Esq., Commander E. H. Verney,
were balloted for, and duly elected Fellows of the Society.

The following papers were read:—

On Certain Appearances in the Telescopic Images of Stars, as described by Mr. Dawes: by the Astronomer Royal.

This paper was a written recapitulation of the observations made by Mr. Airy at the last meeting, with the additional information that Sir David Brewster's paper, on which the Astronomer Royal founded his opinion, was published in the Transactions of the Royal Society of Edinburgh, Vol. xxiv. Part 1.

On the Alleged Difference in Focus of High and Low Stars: by Capt. Noble.

At the last meeting a discussion took place as to the change of focus necessary in observing stars differing in altitude; and the author, finding the night of Sunday, June 9th, remarkably fine, devoted it to a comparison of stars differing not only in altitude, but also in colour. He commenced with Antares, upon which he focussed with the greatest care, and found the companion glaringly visible and the definition admirable. He then turned the telescope on Vega, and found it equally well seen with the same exact focus. Disarranging the eye-piece, he refocussed on Vega, and, dropping down to Antares, again found the vision equally perfect. He next looked at Webb's red star in Aquila, which is of 7·5 magnitude, and finally compared α Herculis and λ Ophiuchi, the same focus serving for all, and not admitting of any improvement. The appearance of α Herculis was exquisite—a single line of golden light being visible round the large star. These results are negative as to the alleged necessity for change of focus, and tend to show that in the very finest state of the atmosphere the focus is identical, but in the more imperfect and normal condition of the lower regions of the air it is very likely the focus may be altered.

The President enquired what was Mr. De la Rue's experience and opinion with regard to the triangular shape of stars, founded on his observations with a reflector?

Mr. De la Rue replied that, under circumstances favourable to perfect definition, the spurious discs were round, but that with other atmospheric conditions they might present any shape.

The President: We are speaking of the discs as seen with a high power.

Mr. De la Rue: My ordinary power would be about 500—quite sufficient to show the peculiar shape.

Mr. Stone: The observations made by Mr. Dawes were so distinct and precise that he could infer the direction of the wind from the shape of the star discs.

The President: And even more than that; he relates a striking instance where, M. Struve being with him, the triangular appearance came on during their observations, and upon going out they found the wind had changed to the East.

Major Tennant: A sudden change of wind would cause currents and disturbance in the atmosphere which must affect the telescopic image. As to the change of focal length, very few persons accustomed to levelling but have found the focus change during the day.

The President enquired how long Capt. Noble's experiments lasted?

Capt. Noble: About two or three hours. I may also state that the wind was NNE., and the temperature pretty uniform.

Mr. Brayley desired to recal attention to the fact that Mr. Dawes ascribed the triangular form to and associated it with the East wind.

Mr. Lockyer said that this point had by no means been lost sight of; and the subject under discussion was, whether the effect arose from physiological causes or could be traced to this particular wind. In his case the form was eminently associated with the East wind, and he had tried to remove it by altering the adjusting screws of his object glass, but without success.

The President: Mr. Dawes not only traced the effect to the cause as he believes, but removes it by an ingeniously contrived aperture.

Mr. Huggins: I had paid much attention to this subject before the recent publicity given to the point, and had corresponded with Mr. Dawes respecting it, and our results agreed perfectly. Perhaps the peculiar effect of the East wind is hardly appreciated; and I may be allowed to explain that instead of having a fine and round disc it appears as if subjected to pressure in three directions. The sides thus pressed in become concave, and the points lengthen out, producing a triangle. The rings follow the direction of the sides. Some nights produce greater distortion than others. Occasionally, the change of figure is instantaneous—sometimes it disappears, at others is very persistent.

Mr. Burr remarked that during a lengthened experience he had always found the East wind produce distortion of the star discs, and that the effect might be likened to an india-rubber ball being pressed and squeezed into various shapes. If, upon observing a star, he found these appearances, he was in the habit of saying there was some East in the wind, which always turned out to be the case.

The President: We are not speaking of the general distortion produced by the East wind, but of the particular triangular shape.

Mr. Burr: That is true; but when everybody testifies that distortion is a result of the East wind, it is a strong argument that one especial form of distortion is due to it likewise, and not to deranged bodily functions.

Mr. Lockyer thought that the fluctuation of the points of the triangle accounted for the various shapes described by the last speaker.

Mr. De la Rue enquired whether the experiment of rotating the object glass had been tried, to see whether the triangle turned with it?

The President: Mr. Dawes tried this, and also observing with a prism in the eye-piece, and even changed the object glass, but without affecting the shape. On the latter occasion Mr. Alvan Clark was with him, so that there were two objectives and two observers agreeing in the result. After the last meeting, when it was stated that reflectors gave a smaller spurious disc than refractors, I determined to investigate mathematically the effect of the interposition of the small mirror which corresponds to a patch in the centre of an object glass. Previously to setting about my task, I thought I would see whether anyone else had dealt with the subject; and upon referring to Mr. Airy's book, and also to Sevardy, I found they had both completely discussed the effect of such a circular patch, and that science and practice agreed exactly, as their result was that such an obstacle to the light tends to diminish the spurious disc and increase the number, diameter, and brightness of the rings. I am at present in possession of one of Mr. With's beautiful 10-inch mirrors, and am well acquainted with the rings and discs; but I found there were some detestable appendages to these, and, trying to find out their cause, I noticed certain projections in the mounting of the plane mirror, and I put an end to them by masking the whole of the small speculum with a circular disc. Directly this was done there was no more breaking up of the rings; all the tails, wings, and appendages disappeared, and I had a beautiful disc with more rings.

Mr. Huggins said that since the last meeting he had tried Mr. Dawes' suggestion of a perforated diaphragm on bright stars, and, using the ordinary perforated zinc for the purpose, found it answer admirably. The size and distance of the holes should depend upon the focal length and aperture of the telescope. In his case, with an 8-inch aperture, the holes were about the tenth of an inch in size.

On an Erratum in the Astronomer Royal's "Undulatory Theory" (Macmillan & Co., 1866): by Mr. Stone.

There is a slight error at p. 80, line 14, of this work, which, when corrected, renders the results obtained by Mr. Knott, in his measurement of star discs, even more accordant with theory than they appeared to be at the time his paper was read.

Occultation of o^2 *Libræ*: by Mr. Talmage.

Observations of Tempel's Comet: by the same Author.

Recent Observations and Remarks of Hofrath Schwabe regarding Sun Spots and other Solar Phenomena: by Messrs. De la Rue, Balfour Stewart, and B. Loëwy.

In his last series of observations communicated to the Kew observers, Schwabe refers to three important results which they indicate—viz., 1. The total absence of faculæ. 2. The absence of scars and pores. 3. The equal brightness of the surface at the edges and centre of the disc. The Kew observations tend to confirm Schwabe's results at the last minimum; and the authors applied to the Rev. Mr. Howlett for his testimony on these points, but the state of his health has rendered him unable to continue his observations. Schwabe also thinks he has found a connection between the sun spots and meteoric showers. Mr. De la Rue and his colleagues are engaged in constructing a curve of sun spot activity derived from the area disturbed instead of the number of groups, which may be an improvement in method. Extracts from Schwabe's journals were read, and the authors stated that in their first joint paper some such general determination of these effects occurring at the minimum had been arrived at.

Mr. De la Rue: The object of this paper is to show that the absorptive power of the atmosphere, which there is no question surrounds the sun exterior to its photosphere, varies from time to time. The faculæ, the amount of degradation of light towards the edges, and the atmospheric action, are all subject to variation. Generally, the tendency is for the greatest degradation of light to accompany the greatest number of faculæ.

A Gentleman present called attention to the fact that the sweating sickness prevalent in England in the middle ages had a periodicity of 11 years, like the sun spots; but Mr. Williams remarked that he believed the disease only recurred three times altogether.

Mr. Lockyer wished to ask Mr. Balfour Stewart whether Schwabe's idea as to the meteors accorded with the Kew theory of planetary influences producing sun spots, as the meteors were now assumed to be of the nature of planets?

Mr. B. Stewart: Our idea is that the mass of the meteors is too small to produce any effect on the sun spot activity. Schwabe's is an entirely independent theory; although it is not endorsed by us, it is not antagonistic to our views. He thinks he has traced a distinct minimum, corresponding with the 33-year period of the meteors.

The President: According to Mr. Alexander Herschel, if all the meteors were added together, we should have more to do with pounds than tons.

Mr. Stone: In the present state of astronomy, I do not think the idea of the addition of any great mass to our system can be entertained.

Note on the Importance of Spectroscopic Examination of the Vicinity of the Sun during Total Eclipses, in order to ascertain the Existence of an Atmosphere, and on its possible Identity with the Zodiacal Light: by Mr. E. W. Brayley.

Many circumstances show that the sun is surrounded by a very extensive atmosphere. Sir John Herschel has pointed these out, and Mr. De la Rue's photographs prove that if the red flames be clouds in such atmosphere, the latter must reach 72,000 miles from the sun's surface. The Corona, likewise, in 1860 and at other times, has had projections which extended many radii of the sun. The luminosity of the red clouds is great, and so is their actinic power. They probably consist of the metals discovered by Kirchoff in the sun, volatilised by the great heat, which Sir W. Thomson has calculated would convert a planet into vapour at the distance of a few hundred thousand miles. The luminosity of such an atmosphere is necessarily very faint by contrast with the photosphere, and it is therefore generally invisible; but during a total eclipse there would be the possibility of ascertaining its extent by spectral analysis, and hence the importance of taking advantage of such an opportunity. The photosphere is the source of light and heat, and the absorptive atmosphere produces the Fraunhofer lines of the spectrum; but the atmosphere itself, when viewed with a prism, should give a monochromatic spectrum, the bright lines of which would indicate the constitution of the atmosphere, and the author suggested that it would correspond with those of the unresolved nebulæ. This atmosphere is probably conterminous with the zodiacal light, and its components may condense into meteors; while the author thought such an extent of the zodiacal light, considered as an atmosphere, not inconsistent with known dynamical laws. There were very few records of telescopic observations of the zodiacal light, and none at all with the spectroscope. Under favourable circumstances it should give a monochromatic spectrum of bright lines, and the meteoric particles might produce a faint continuous spectrum. The paper was written with especial reference to the coming eclipse of 1868, to direct attention to the particular class of observation suggested.

The President: In 1860, the rays or appendages to the Corona extended so many diameters of the sun, that it was universally agreed they were due to our atmosphere.

Mr. Lockyer wished to ask Mr. Brayley whether he was aware of the latest observations of M. Lias, who had been sent by the French Government to Brazil; and the result of his enquiry appeared to be, that if the zodiacal light exists at all, and goes round the sun, it extends outside the earth's orbit, and when seen in the West is also visible in the East. This corroborates the statement of the Rev. Mr. Jones, chaplain in the American navy, who says he saw this effect in China. The question of the spectrum analysis of the solar atmosphere had not been lost sight of; both Mr. Stone and the speaker had travelled with the spectroscope round the sun's disc, but without success, and the importance of such observations during the eclipse was fully recognised. Mr. Lockyer also made some remarks on the two theories of the solar spots.

The President observed that M. de Chaillu mentioned that he had seen the zodiacal light so intense in Equatorial Africa as to obliterate the Milky Way.

Mr. Brayley: Do you recollect the time?

The President: It is recorded in the account of his last expedition.

A Gentleman remarked that he had somewhere seen a spectroscope observation of the zodiacal light referred to, which resulted only in a faint solar spectrum.

Dr. Mann: My experience in tropical countries has been that the zodiacal light disappears before the Milky Way is sufficiently seen to be compared with it. In fact, it would not be dark enough for the Milky Way to be seen. The zodiacal light appears suddenly, and fades in about 15 or 20 minutes.

Major Tennant: I have seen the zodiacal light and the Milky Way together in the tropics, and the former extending more than 90° from the sun's place. This has been as late as 9 o'clock in February, near the Northern Tropic; and where the two luminosities conflicted, the zodiacal light put out the Via Lactea; but I have never seen the light in the East and West at the same time.*

Mr. Huggins: It is desirable that it should be known that the best way of observing the spectra of the bodies referred to is with the simplest possible apparatus. Nothing but the prism and a tube should be used—the latter having a slit about 10 inches from the eye, which should be contracted gradually till nothing could be distinguished. The same method was best for viewing the Aurora. Dr. Gladstone had done this, and seen a line in the red, somewhere about the position of the hydrogen line. A telescope should not be used in such observations, as the only effect was to dim the light.

The President corroborated Mr. Huggins as to the ease with which the Wollaston-Fraunhofer lines could be seen with the simple arrangement of a prism and slit.

Mr. Huggins further observed that we were provided with a natural apparatus for the purpose. By opening the fingers more or less, an excellent and adjustible slit was obtained—the hand being held at the proper distance for distinct vision.

Major Tennant drew attention to a curious anomaly observed in the course of Col. Walker's *Pendulum experiments in India*. The observations were conducted by Captain Basevi, who had been instructed how to make them at Kew; and upon reduction it appeared that when the atmospheric pressure was reduced to 5 inches of mercury, the co-efficient of expansion increased to thirteen times the amount ever observed before in brass. Some anomalies were noticed at Kew which could not be traced to temperature, and it therefore became desirable to ascertain whether differences of pressure altered the size of a solid body.

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* See vol. xiv., Monthly Notices, for Papers by Mr. Burr and the Rev. T. W. Webb, which show that even in England the zodiacal light is sometimes seen to exceed the Via Lactea in brilliancy.—Ed.

The President: Did not Dr. W. H. Miller make some experiments on this point, in connection with the standard weights?

Major Tennant: I am not aware of them.

Mr. Balfour Stewart: With regard to determination of the coefficient of temperature in swinging pendulums, the observations for that purpose had better be made on the spot where the experiments take place. It should be remembered that the pendulums are not made in one piece, which may have an influence.

The President: I believe these instruments are only brass?

Major Tennant: Yes; but the result is so remarkable that, although I am not responsible for the observations, I thought it worthy of notice here, as the subject ought to be investigated independent of temperature.

Mr. Stone: Might not the nature of the vessel in which the swinging takes place have some effect?

Mr. B. Stewart: This would be very material.

Determination of the Longitude of the Sydney Observatory, from Observations of the Moon and Moon-culminating Stars: by Mr. Stone.

On the Approximate Dimensions of 71 Asteroids: by Mr. Stone.

Assuming that light is reflected equally by all these bodies, and using Mr. Pogson's magnitudes, the author deduced the diameters, which he found to range between 17 and 214 miles.

On the Changes in the Lunar Crater Linné: by Mr. Birt.

In a letter from Professor Mädler, dated June 6, 1867, he gives the following information as to this crater:—

"The crater Linne, situated in 27° 47′ 13″ N. lat., and 11° 32′ 28″ W. long., has a diameter of 1·4 geographical miles (6·4 English miles). In full moon the edge of it is not very sharply limited, but in oblique illumination it is very distinct, and I have measured it seven times with great facility. The light of the edge is noted permanently 6°; the very small inner space has nearly or full the same brightness till the moment when shadows begin. I measured its co-ordinates in 1831, Dec. 12th five times, and Dec. 13th twice."

During December 1866, no observation of the interior or margin of the ancient Linné *as a crater* was obtained. It was seen as a white diffused patch of light, with the following exceptions:—

Dec. 13, Herr Schmidt saw *on* Linné a very delicate *hill*, which he estimated as between 30 and 40 English feet high, and about 1,900 feet in diameter.

Dec. 14, Mr. Buckingham, with his 9-inch equatoreal, powers 240 and 361, saw a shadow, or very black spot, near but on the west of the centre of Linné.

Dec. 26, Herr Schmidt saw *on* Linné a very fine black point, about 1,700 English feet in diameter, with a fine white summit to the west.

Taking into consideration the appearance which Linné presented to Lohrmann in 1823—viz., that of a *deep* crater (1,087 English feet, according to Schmidt)—it would seem, from the constancy of the phenomenon of an aureole, or white cloudy patch, which it has presented since 1866, Oct. 16, at those periods of illumination when the sun is near its horizon, that both Schmidt's and Secchi's suggestion is correct, and that the ancient crater has been *filled* to the summit of the rim, the declivity therefrom outwards being very gentle. This state of things was observed for two months—viz., October and November 1866. It must, however, be borne in mind that the attention of astronomers in this country was not called to the state of Linné until early in December 1866; still, Schmidt, the discoverer of the change, did not notice the black point until December 26, under the evening illumination, Buckingham having seen it under the morning. It is this black point which is now becoming a most interesting feature. Resolved into a crater by Secchi on Feb. 11, 1867, it does not appear *strongly* to have arrested the attention of astronomers until two months afterwards—viz., in April—when it was undoubtedly seen either as a true crater, or detached features of it were detected—the first by Messrs. Buckingham, Webb, and Carpenter; the latter by Messrs. Huggins and Dawes. Although in May the weather was so bad at the time most favourable for the inspection of Linné, yet it was seen by two observers with good optical means (Messrs. Huggins and Knott), in so distinct a manner as to leave very little doubt of the high probability that the orifice seen on December 14, by Buckingham, as a black spot, has become so enlarged as to present the true form of a crater.

Mr. Birt also exhibited specimen portions of the new map of the moon, on the scale of 200 inches in diameter, prepared under the direction of the British Association Lunar Committee.

The President: Are we to understand that this *thing* on the moon is expanding and contracting? Mr. Huggins has handed me a drawing made on May 11th, showing Linné as a white spot, with a whiter ring and a black speck on it.

Mr. Buckingham: Permit me to say that, having optical means second to none, I am sure the black spot has been increasing during the latter months. On Sunday last I could see the *crater* and *into* the crater, and the shadow on the interior. The crater does not exceed 1″ in diameter, and is not concentric with Linné, but nearer the western side—Linné being about 6″ across. When Secchi first saw the crater, he estimated it at one-third of a second only.

Mr. Beck: It is certainly most desirable that drawings of these different appearances should be made and preserved. The evidence seems to prove that the spot is three times as large now as in December.

Mr. Huggins: Respighi, who has made careful observations in Italy, says that the crater as now seen agrees so closely with the old observations that he thinks no change whatever has happened on the moon.

Mr. Birt: Much depends upon the time of observation. Schmidt says the difference is only to be seen under oblique illumination. At full moon the appearance is the same as it has been for the last 25 years.

Mr. Browning said that he feared he could do little to explain the varying accounts, as he was not at all positive as to the former aspect of Linné; but he had placed on the wall an enlarged copy of Beer and Mädler's delineation, and a drawing of its present aspect, from which anyone would see there must have been a change. That excellent observer, the Rev. Mr. Webb, also felt certain that had Linné presented the features it now did, no such difference could have existed between the map and the truth, as was now apparent. He (Mr. Browning) was sure that three months ago there was no small black spot at all, while now he was certain of one. If persons had any faith in Beer and Mädler they must be certain of change, as Beer and Mädler could not have drawn a large white spot as they have done. At most of the observations Mr. Browning had made, there was an effect as if looking through a volume of boiling steam or vapour.

Mr. De la Rue said the copy from Beer and Mädler's map must not be taken as representing the telescopic appearance of the crater, but only as their conventional method of representing certain peculiarities. Photographs show that their delineations are erroneous in form. Recent photographs, as compared with former ones, show no evidence of change; but in so minute a portion this was not conclusive. His own idea was that no change had taken place. There could be no doubt of the existence of the central crater being as well defined as any other part of the moon's surface, and that it was situated in a shallow cup.

Mr. Browning: When seen last Sunday, much of the increased distinctness might be due to the improvement of the weather. All around Linné were objects not one-fifth of the diameter of the little crater, as black and distinct as possible.

The discussion then terminated, and the meetings were adjourned till November.

THE TIDES.—"*A New Theory of the Cause of Tides*" is the title of a pamphlet by Mr. John Culbertson, in which the ebb and flow of the tide is attributed to certain positive and negative states of electricity in the earth, sun, and moon.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

PUBLICATIONS OF THE ROYAL ASTRONOMICAL SOCIETY.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I have read with genuine pleasure "A Fellow's" letter on the shabby system practised in regard to the Society's publications, and I do hope that his letter in your journal may initiate an agitation which will not cease until the *Memoirs* are distributed gratuitously, and the *Notices* published regularly by the 1st of every month. Agitation has already done good. We have secured two efficient secretaries instead of one; we have obtained a room, set apart for reading, at Somerset House; we have seen the periodical publications provided with covers, and arranged in an orderly way on a table in the said reading-room; and, generally, signs that stagnation is no longer to be the order of the day. Now, I confidently ask, and with some knowledge of behind the scenes, would any one of these beneficial changes have happened if there had not been pressure from without? That being so, let some one take in hand the question of the *Memoirs*. I will do so myself if no one else will. I am prepared to advocate a free distribution to all the Fellows as a matter of right; but if the Council can fairly prove that the Society cannot afford to go to that length, then I will be content with some such lesser scheme as the following: Let it be stated what number can be afforded, and let that number be distributed to the Fellows in the order of their application as far as the supply will last, making, if you please, applicants sign some such declaration as the following:—"I, A. B., hereby declare that I am engaged in practical work calculated to promote the development of astronomy, and that I believe my labour would be facilitated by my being placed in possession of the *Memoirs* as they are published."

All this, of course, is mainly prospective, but I see no reason why the *principle* should not be carried out as to old volumes of *Memoirs* now in stock. Will it be believed that at this moment there are now rotting in the apartments of the Society nearly 8,000 copies of the various volumes and parts of *Memoirs*? It seems to me that there is a glorious opening for a grand reform.

Your obedient servant,
A LITERARY F.R.A.S.,
WHO GRUDGINGLY PAYS HIS £2 PER ANNUM.

June 5, 1867.

Sir,—I have read with much regret, in your number for June, a letter from "A Fellow of the Royal Astronomical Society." Sympathising with him as to the return for our subscriptions to a great extent, I beg to protest against the personality introduced into his letter. It is very much to be desired that our *Memoirs* could be given gratis to all the Fellows; but your correspondent must be a new Fellow, or he would be aware that the matter was mooted and discussed in Council, and that they were deterred on account of the expense attending it. In fact, if your correspondent will inquire, he will find that the whole edition of the *Memoirs*, as now published, would barely be enough (if enough) to supply all the Fellows; and the fact that so very few copies of the *Memoirs* are sold at the reduced price (which is very moderate), is sufficient to show that the *Notices* supply the wants of a large majority. I cannot blame the Council, who are responsible for the finances, if they do not feel bound to convert the surplus they now have into a deficit, by having a very much larger edition of *Memoirs* and *Notices* printed.

Possibly the Council might find it in their power to aid by grant some astronomical research; but I acknowledge that when I consider the absolutely insignificant aid they could give to any systematic investigation, I see great difficulties. Still, it is in that form I should wish to see our own surplus income expended.

I have no doubt the Council would regret to find that any person who has rendered so eminent a service to our science as to be placed on their free list makes money of the compliment, but there can be but few such.

I have no doubt if your correspondent would communicate with the secretaries, or would take the trouble to find some member of the Council of the same views, he would find no difficulty in getting information which would enable him to make a scheme for increasing the return for our subscriptions, and I am sure that such scheme would be carefully considered; but he must avoid personality, and he must further remember that his views as to the value of the *Memoirs* are probably not shared by many, and that there is one great difference between the cases he quotes and the Astronomical Society. A very large portion of their proceedings, even in the case of the Royal Society, is interesting to most and intelligible to all the members. Long lists of the Numerical Results of observations are probably interesting to few, and Mathematical Investigations, such as often occupy our pages, to fewer of our Fellows. Nearly everything that is generally interesting appears in full in the *Notices*.

I am not a member of the Council, and have spent a very large proportion of the years I have been a Fellow of the Society abroad, and probably very few members have had less of the advantages of the Society's meetings; so that I have no object but to set forth what I believe to be facts, which ought to be known to reformers, of what exists, and am,

Yours faithfully,

June 14, 1867. ANOTHER FELLOW, R.A.S.

Sir,—I am sorry to see that a most uncalled-for attack upon Mr. Cayley, from an anonymous correspondent, has been allowed to appear in this month's number of the *Register*, and I think the Fellows of the Royal Astronomical Society have a right to know the name of the writer of the letter headed "The Publications of the Royal Astronomical Society," and I hope it will be given in your next number. It may be all very well to discuss in the *Register* the question as to the return we obtain for our entrance fee and subscription to the Royal Astronomical Society, but such a discussion ought not to be used to cover an unwarrantable attack upon any individual member of the Council.

I am, dear Sir, yours very faithfully,

Manchester, June 1, 1867. JOSH. BAXENDELL.

Sir,—I hope that in the next number of your periodical you will give publicity to the fact that the librarian of the Royal Astronomical Society will for the future be in attendance *always* on Monday, at the Society's apartments, between the hours of 11 and 3. To those who, like myself, have often made fruitless journeys thither, this will be a great boon, rendering that most valuable library available, which hitherto can scarcely be said to have been the case. Yours obediently,

X.

REFRACTION ACCORDING TO MR. HICKSON.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—It would be impossible to find a better proof of the hopeless way in which Mr. Hickson misunderstands the question under discussion, than that afforded by his own illustration of the refractive power of the atmosphere. Put shortly, his argument is, that because the Sun appears elevated above the horizon when it is really beneath it, *therefore* the atmosphere acts "as a magnifying lens, by collecting and converging the rays of light." Will Mr. Hickson allow me to suggest a simple experiment to him? Let him obtain a thick piece of plate glass; now, let him place a printed book upon the table, and lay a ruler upon the open page; next, let him retire from the table until this ruler just conceals any given word; finally, let some one place the piece of plate glass upon the printed page, and Mr. H. will find that the word previously concealed by the ruler will become visible again. Here, then, is the precise analogue of the phenomenon which Mr. Hickson selects to prove his case. It only remains to carry out his premises to their logical conclusion, and assert that a plate glass window acts upon "bodies beyond it, as a magnifying lens, by collecting and converging the rays of light!"—so that external objects, invisible with the window open, must be easily seen as soon as it is closed! Your correspondent's reference to Berkeley's "Theory of Vision" is merely irrelevant. He seems to have studied it a long time before I was born, and can scarcely have looked at it since; or I think he would hardly import it into this argument. Suppose that, by way of a change, he reads carefully chapter 4 of Brewster's "Optics," (especially sec. 38 to the end of the chapter); Galbraith and Haughton's "Manual of Optics," chap. 2 *passim*; and chapters 4 and 5 of Lardner's "Optics." Having done so, if he will draw two concentric circles on a piece of paper, to represent the surface of the Earth and the boundary of our atmosphere, and endeavour to trace the manner in which the light from a star or planet is "collected and *converged*," I cannot help feeling that he will be in a position to produce something better worth reading than his last communication to the *Astronomical Register*.

I am, Sir, yours very obediently,

May 5, 1865. N.

METEOR-LIKE BODIES SEEN NEAR THE SUN.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—If you should think it worth while to refer to the meteor-like objects described in a letter of mine to the *Birmingham Daily Post*, a copy of which I sent you, I should be glad that an error in the account might be corrected. It was stated that the direction in which the objects moved was from the south-east to the north-west; instead of this, it should be *from the north-west towards the south-east*. I was misled in using a diagonal prism. I soon perceived the error, but was too late to get it corrected in the newspaper.

The objects described in the letter were very remarkable, and most meteoric in appearance. I have my doubts as to whether they were really meteors, the velocity being much less than those bodies usually have. It has been suggested that they were seeds, or possibly insects, strongly illuminated by the sun. One correspondent refers to an account, in the *Leisure Hour*, of a similar appearance last September, and ascribes it to the seeds of the poppy or groundsel; but as these plants are not in flower even at the present season, it is out of the question to ascribe it to them. The day was unusually calm, with a brilliant sun. Mr. Lowe, of Atherstone, informs me that he saw something of them a day or two before in the finder of his telescope, but did not look for them in the large instrument.

Yours faithfully,
F. BIRD.

[These objects were observed by Mr. Bird in the morning of May 30.

On reading Mr. Bird's letter in the Birmingham paper, Mr. A. S. Herschel considered that the objects seen must have been snow flakes; the great difference in their speed being against their meteoric character.—Ed.]

NOVEMBER METEORS AND THE "SWEATING SICKNESS."

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—At the meeting of the Royal Astronomical Society, on Friday last, one of the Fellows mentioned, as a remarkable circumstance, that the "sweating sickness," a fatal disease that ravaged England in the reigns of Henry VII., Henry VIII., and Edward VI., returned in periods of eleven years, and that these periods might possibly have some connection with the November meteors. In order to test the probability of this supposition, I have since examined the historical accounts of this singular disease which have come down to us, and now beg leave to lay the result before your readers, premising that my principal authority for the dates is the well-known old historian, Stow.

The "sweating sickness" made its first appearance in England in the year 1485, a short time after the battle of Bosworth. It was a very fatal epidemic, very few, if any, of those first attacked recovering, and the generality of these perishing within twenty-four hours. Its career was fortunately but of short duration, as it commenced on the 21st of September, and ceased at the end of October. Within this short time, two Lord Mayors (some writers say three), four aldermen, and a vast number of other persons died of this complaint. The next return was in 1517, about Trinity Term, when very many of the inhabitants of the metropolis were destroyed by it. It again appeared in June 1526, with similar fatal results. In 1551, about April 15th, it once more returned, and carried off a vast number of persons. From that time the disease has not appeared, having occurred altogether but *four* times, and those during an interval of 66 years. I may mention a supposed peculiarity of this epidemic. It was confidently asserted that none but natives of England were subject to its attacks, even when it occurred, as it actually did, in foreign parts, and consequently it received the name of "Sudor Anglicus;" but there are abundant reasons for believing that this supposed exclusiveness had no real foundation.

Let us now see how far the dates given by Stow agree with the eleven years' returns of this disease.

The first attack was	in 1485.		
The second „	in 1517.	After	32 years.
The third „	in 1526.	„	9 „
The fourth „	in 1551.	„	25 „
Making together . . .			66 years.

The only approach I can perceive in these numbers to an eleven-year period is in the total of 66 years, which is certainly made up of six periods of eleven years each; but I will leave it to your readers to form their own conclusions as to how far the eleven-year theory is borne out or invalidated by the facts I have mentioned. I must, however, observe that it appears to me that any apparent coincidence is purely accidental, and consequently that the November meteors must be considered as wholly guiltless of exciting the dreadful disease recorded as the "sweating sickness."

I must, however, in fairness mention that some later writers make the third attack to have been in 1528 instead of 1526. This *would* give one period of eleven years; but Stow, who lived near the time, and was a most careful and indefatigable inquirer into the truth of the historical facts recorded by him, unhesitatingly gives the year 1526 as the date of that visitation.

I am, Sir, very truly yours,

June 17, 1867. J. W.

SILVERED GLASS REFLECTORS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—It must be extremely gratifying to every lover of astronomy to read the announcement in your last number of the intention of Mr. Dawes to examine the capabilities of these beautiful instruments in comparison with refractors; the results of such a trial will be looked forward to with the greatest interest, and the more so as we are all aware that it could not be performed by more competent hands.

In the face of this, any remarks from such a tyro as myself might seem out of place; but as several observers have corresponded on the subject, I thought a few notes, for the sake of comparison, might be of interest.

Little more than two months back, Mr. With, aware of my inability to procure suitable optical assistance, very kindly presented me with one of his excellent 6½-inch mirrors of 5½-feet focus, and several other friends kindly contributed towards the expense of mounting, which has been successfully accomplished, the movement being a simple but efficient equatorial. At the outset, Mr. With warned me of the plane, which, though very good, was not to be relied on, especially under high powers. He advised the purchase of one of Mr. Browning's warranted planes—a suggestion I hope to soon carry into execution. Added to this, the eye-piece was but ill adapted to the instrument, being a small pancratic, giving powers of 50, 65, and 80 on my 3-foot achromatic of 2-inch aperture. In this condition the telescope showed minute stars well: the companion of Polaris was very distinct, and γ Leonis and ϵ Bootis were well separated, the power being but 120. The cluster 3 Messier, between Arcturus and Cor Caroli, was a superb object; myriads of small stars like glittering dust appearing on the borders, while the centre was a blaze of nebulous light. Notwithstanding these results, it was impossible to obtain clear, round, well-defined images of the discs of bright stars, the most careful focal adjustment failing to clear the image of a large amount of coarse straggling rays of light, which I attributed to the imperfections of the plane mirror. While pondering on this, and trying to devise a remedy, I received a welcome present of one of Mr. Browning's beautifully perfect achromatic eye-pieces, which I lost no time in adapting to my telescope; the result being that I found myself in error in blaming the plane for the imperfections, which I at once saw were almost wholly attributable to the unsuitable construction of the eye-piece I had been using: and from what I have seen, I cannot but think that these excellent adjuncts to a reflector only require to be more widely known to be generally adopted. Of the few objects I have had leisure to examine, ϵ^4 and ϵ^5 Lyræ has received considerable attention, since it furnishes tolerable tests both for light and definition. With the moderate power used—220—I found the discs of the components of each pair beautifully round and splendidly defined; and from having observed this object with the Hartwell equatorial, of $5\frac{9}{10}$ aperture, with a power of 240, I am not unacquainted with its appearance in a fine achromatic. On a comparison of what I now see in my reflector, I think I am not far wrong in ranking the 6½-inch mirror as equal in definition to a fine 5½-inch object glass. As to light, I found the "debilissima" couple, ranked as 13 magnitude, very distinct—in fact, easily seen. I see them considerably unequal, the northern star the largest, probably ½ magnitude brightest. Two more minute points I have suspected—one situated North of the most following of the "debilissima,"and about ⅓rd of the distance between that and the most northern pair; the other North preceding of the most southern of the "debilissima." Both these minute points I estimate about 15 magnitude. This I think highly satisfactory as a light test, as is also the clearness and beauty of the annular nebula in the same constellation. The planet Saturn is so low that it is next to impossible to get a satisfactory view of its details; but I have seen, beautifully distinct, the division of the ring, the inner dusky ring, the belts, and five satellites.

Some time ago one of your correspondents complained of the annoyance caused by a bright vertical and a fainter horizontal ray of light shooting out from the image of a bright star in the reflector, arising from the interception of light by the arm carrying the plane mirror. I find no inconvenience from this cause, the rays even on the largest stars being scarcely perceptible. The arm carrying my plane is less than the $\frac{1}{16}$th of an inch thick, and about ⅝ths wide; the edge only being presented to the large mirror, is not sufficiently thick to cause a ray.

A correspondent asks if the silvered specula could be successfully mounted in the Herschelian telescope, his object being obviously to avoid the loss of light in the second reflection from the plane mirror. In this the reflection is necessarily a distorted one; besides which, the instrument would be much less convenient in use, since, when directed to a star near the zenith, the observer must look down vertically on the mirror, whilst in the Newtonian the eye-piece can be rendered horizontal in all positions of the instrument—and it is questionable whether these conditions would not be more detrimental than the small loss of light, since the silvered glass specula are vastly superior in this respect to those of metal.

I am, yours very truly,

Blucher Street, Chesham, Bucks: C. GROVER.
June 10, 1867.

THE METEORS OF APRIL LAST.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Last month I wrote you that I was prevented from seeing any of the meteors of the 20th of April last, in consequence of the cloudiness of the night here. Mr. Birmingham, of Millbrook, Tuam, informs me that, although the sky was clear in his neighbourhood, and he was watching some hours, yet he saw "not a ghost of a meteor in Lyra, and scarcely one elsewhere." It appears, however, from a letter by Dr. Galle in the last number of the *Astronomische Nachrichten*, that Professor Karlinski, of Cracow, was more successful, and observed, between 12h. 20m. and 14h. 50m. Local Mean Time, the tolerably considerable number of 19 bright shooting-stars, chiefly of the first or second magnitude. The path of one of these was determined without sufficient certainty, as it very closely preceded another: two more were remarked to be "sporadic," or evidently proceeding from a point differing from the radiant point of the others. Dr. Galle has carefully determined the radiant point deducible from the remaining 16, which had already been approximately done by Karlinski himself. The result gives as the co-ordinates of that point, referred to the equinoctial, R.A. = 278°·2, declination = 34°·5 North. This agrees very closely with the best previous determination of that point, by A. S. Herschel, published in the Report of the British Association for 1864, which gave R.A = 277°·5, decl. = 34°·6 North. It tends, therefore, to the confirmation of the conjecture alluded to in page 109 of your current volume, that the orbits of the April meteors and of Comet I. 1861, have at least a very considerable resemblance to each other.

Dr. Galle writes that he has hitherto heard of no observations at other places—neither have I; but I yet hope that other observers may also, besides Karlinski, have been more successful than Mr. Birmingham and myself.

If you can insert this in the next number of the *Register*, you will oblige

Yours faithfully,

Greenwich: 1867, June 17. W. T. LYNN.

From the *Cologne Journal*, Friday, March 1, 1867 (translated by W. T. Lynn, Esq., B.A., F.R.A.S.)

Disappearance of a Lunar Crater.

The report we have just received of the Imperial Academy at Vienna contains an extract from a letter from J. F. Julius Schmidt, the Director of the Observatory at Athens, to Herr Haidinger, which was read by the latter at the meeting of the 7th of February. It relates to the indication of a change on the surface of the Moon, the first proof furnished with perfect certainty of such a change in the history of the observation of our satellite. The report as given by Haidinger runs thus:—

"One of the craters of the Moon exists no longer. On the 16th of October 1866, Julius Schmidt remarked that the isolated crater on the eastern part of the *Mare Serenitatis*, marked A in Lohrmann's Section iv., but which in Mädler bears the name of Linné, no longer existed as a crater. The following observations in October, November, and December, in both waxing and waning moons, showed that, even under otherwise favourable circumstances for the visibility of such small craters—namely, for altitudes of the Sun from 2° to 20°—there was visible at no time a crater, but only either a whitish cloud or a smooth plain casting no shadow. Much smaller craters in the neighbourhood were, however, very easy to recognise as such. The crater Linné, 5,000 to 6,000 toises broad, and formerly very deep, served in the measures made by Lohrmann and Mädler for a fixed point of the first order. On Schröter it appears once in the large collection of studies of the Moon's surface. In the years 1841 and 1843, drawn and preserved by Schmidt himself, it appears distinctly as a crater. This manuscript collection embraces, since 1840, 95 whole phases in Hevelius's manner, and more than 1,200 hand drawings, all not published. He had drawn the phases at Entin, with a Dollond of about fifteen times magnifying power, with very sharp definition; the other images since 1842, with larger instruments (refractors of from 4 to 14 feet focal length), at Hamburg, Bilk, Bonn, Berlin, Olmütz, Rome, and Athens. Schmidt gives very carefully all references to the subject since 1788, from the works of Schröter, Lohrmann, and Mädler, and then records his own many observations up to and including Jan 15, 1867. Incontestable now is the fact that changes are taking place in the figure of the lunar surface which are not apparent, but real. The author gives, in a little accompanying letter, a short survey of the hypotheses which are stated in detail in the treatise, as questions naturally arise concerning the nature of the phenomenon.

"An eruption of vapour or ashes is not probable, because a shadow of that which covered the crater would be thrown at sunrise and sunset; but this is never the case. Such must *also* be visible at the phase, which is not the case. Had the crater sunk below, in its place a great shadow would be visible during the phase. Had the ring mountain been destroyed, the fragments would throw shadows, which also is not the case. Had the crater been filled up by an eruption of fluid or powdery matter without overflowing, the interior black shadow at sunrise and sunset would indeed disappear, but there would remain a hill throwing a shadow on the outside. This was the appearance seen by Schröter in 1790, in the central crater of Posidenius, and by Julius Schmidt in the same object in the month of February 1849. But such a mass of matter may also have flowed out over the outside banks and covered the surrounding declivity with very gradually sloping inclination. This would prevent the casting of a shadow outside at the phase. Such an event would explain all the phenomena presented by Linné, and it is the kind of event which in the mud volcano of the Peninsula of Taman, so closely described by Abich, has so striking an analogue upon our earth. The spreading of the overflowing bright mass over the dark plain gives occasion to the origin of broad formations similar to a halo which are frequently seen upon the Moon, especially in the so-called '*Maria.*' Here lies the key to the new enquiries and points of view; a hope for the future.

"Herr Schmidt had already received information from Mr. W. R. Birt, of London, one of his correspondents, that the latter had also confirmed the fact of the disappearance of the crater Linné, and that an account thereof had been communicated by a circular of the Lunar Committee to astronomers interested in it.

"The long and indefatigable exertions of our highly honoured friend Julius Schmidt have therefore been crowned by a result for which even Mädler, although he did not resign the hope, remarked, however, that although he had laboured to discover traces of changes on the Moon's surface, he was obliged to confess that all the labours hitherto spent upon that object had led to no positive results. (*The Natural Sciences, &c.*, vol. iii., p. 573.)

"What agonising interest would this event have given to our immortal Humboldt, who, in his *Kosmos*, places together in their order Lohrmann, Mädler, Julius Schmidt, for their instructive and original labours upon the Moon (for example, in vol. iv., pp. 614 and 615), and who constantly took interest in and recognised with pleasure the value of the results of the labours of the latter."

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The great interest that has been excited in the study of Lunar Physics, in consequence of the discovery, by Schmidt, of an alteration in the appearance of the crater *Linné*—his subsequent suggestion that the older crater has been filled to overflowing by "an eruption of fluid or powdery matter" (see *Intellectual Observer*, vol. xi. p. 216, April 1867)—the more recent discovery by Father Secchi of a small crater *on the surface of the erupted material* (see same number of the *Intellectual Observer*, p. 222), which has been confirmed by the observations of Buckingham, Carpenter, and Webb, especially on the favourable evening of the 11th of April 1867—the high probability (from a careful comparison of these observations) that the *small* crater has resulted from the "eruptive force" *maintaining an outlet* through the erupted material (a supposition confirmed, in a measure, by Mr. Carpenter, of the Royal Observatory, Greenwich, who says, "I do not think I have ever missed some trace of a crater form"), thus keeping the orifice of *Linné* open,—these facts and considerations suggest the importance of most carefully watching the appearances of this interesting spot, especially when the morning and evening terminators are near it. I have accordingly computed the accompanying Ephemeris of the epochs during the remainder of the present year, at which it will be favourably illuminated—*i.e.* when the differences between the longitudes of *Linné* and the respective terminators are less than 13°, or generally when *Linné* is within one terrestrial day of sunrise or sunset. In some instances, when the differences are small, the *succeeding* day in the case of sunrise, and the *preceding* day in that of sunset, will be very favourable for observing *Linné*.

I am, Sir, your obedient servant,
W. R. BIRT.

42 Sewardstone Road West, Victoria Park:
London, June 1867.

Ephemeris, Linné, near Sunrise.

Linné, Longitude 11° 32′ 5″ W.; Latitude 27° 47′ 2″ N.
Morning Terminator.

Date	Long.	Angle η	Distance
1867 d. h.	° ′	° ′	° ′
July 8 8	6 3·5 W.	− 1 21	+ 5 29·0
Aug. 6 8	11 38·9 W.	− 0 49	− 0 6·4
„ 7 8	0 34·2 E.	− 0 47	+ 12 6·7
Sept. 5 8	5 16·6 W.	− 0 2	+ 6 15·9
Oct. 4 8	11 31·8 W.	+ 0 44	+ 0 0·7
Nov. 3 8	6 4·7 W.	+ 1 20	+ 5 27·8
Dec. 3 8	1 4·1 W.	+ 1 32	+ 10 28·4

Ephemeris, Linné, near Sunset.

Linné, Longitude 11° 32′ 5″ W.; Latitude 27° 47′ 2″ N.
Evening Terminator.

Date	Long.	Angle η	Distance
1867 d. h.	° ′	° ′	° ′
July 21 16	23 5·2 W.	− 1 8	+ 11 32·7
Aug. 20 16	16 33·1 W.	− 0 28	+ 5 0·6
Sept. 18 16	22 34·4 W.	+ 0 19	+ 11 1·9
Oct. 18 16	16 51·5 W.	+ 1 3	+ 5 19·0
Nov. 16 16	23 48·0 W.	+ 1 28	+ 12 15·5
„ 17 16	11 38·0 W.	+ 1 29	0 5·5
Dec. 16 16	18 56·0 W.	+ 1 28	+ 7 23·5

Notes.—The above tables give the distances in the fourth columns of the meridian on which *Linné* is situated, from the meridian crossed by the terminator at the respective days and hours, G. M. T., in the first columns of each. The second columns, headed "Long.," contain the longitudes of the terminator at those days and hours. The Angle η is that which the terminator forms with the meridian which it intersects, and is + when the N. pole is enlightened, and − when it is in darkness. If the longitude of the terminator were the same with the longitude of *Linné*, *Linné* would be in sunlight with the Angle η +, and in darkness if it were −; for with the N. pole illuminated, the terminator would pass eastward of *Linné*, and westward of it when the S. pole is enlightened. On the evening of August 6, the terminator will be very near *Linné*, and may reach it before moonset. On October 4, *Linné* may be observed *on* the terminator. On the morning of Nov. 18, the evening terminator passing E. of *Linné* when the longitudes coincide, it is doubtful if *Linné* will be visible without further calculation, but it may be well observed on the morning of the 17th. The sign + in the fourth columns signifies that *Linné* is illuminated.

ASTRONOMICAL OCCURRENCES FOR JULY 1867.

DATE		Principal Occurrences h. m.		Jupiter's Satellites	h. m. s.	Meridian Passage h. m.
Mon	1	9 2 9 48	Sidereal Time at Mean Noon, 6 36 16·9 Conjunction of Moon and Uranus, 5° 0′ N. ● New Moon			Saturn — 8 26·2
Tues	2			3rd Tr. E. 4th Tr. I. 2nd Ec. D.	12 0 12 32 15 6 50	8 22·2
Wed	3	7 24 8 12 12 46	Conjunction of Moon and Mercury, 3° 33′ N. Conjunction of Mars and ρ Leonis, 9m.·4 W. Conjunction of Mercury and δ Cancri, 3m.·0 W.			8 18 1
Thur	4			2nd Tr. I. " Sh. E. " Tr. E. 1st Sh. I.	11 38 12 17 14 29 15 7	8 14·1
Fri	5	9 56 20 26	Conjunction of Moon and Mars, 1° 47′ N. Greatest easterly elongation of Mercury, 26° 11′	1st Ec. D. " Oc. R.	12 19 7 15 43	8 10·0
Sat	6		Meridian passage of the Sun, 4m. 22s. after Mean Noon	1st Tr. I. " Sh. E. " Tr. E.	10 42 11 55 13 1	Moon. — 4 23·8
Sun	7					5 12·3
Mon	8	5 31	☽ Moon's First Quarter			5 59·0
Tues	9			3rd Sh. E. " Tr. I. " Tr. E.	11 23 12 0 15 35	6 44·7
Wed	10	17 24	Conjunction of Moon and Saturn, 2° 15′ S.	4th Oc. R.	13 48 40	7 30·1
Thur	11	10 15 11 25 14 10	Occultation of η Libræ (6) Reappearance of ditto Conjunction of Mars and χ Leonis, 4m.·7 E.	2nd Sh. I. " Tr. I. " Sh. E.	11 59 14 2 14 54	8 15·7
Fri	12			1st Ec. D.	14 13 22	9 1·9
Sat	13			1st Sh. I. 2nd Oc. R. 1st Tr. I. " Sh. E. " Tr. E.	11 29 11 46 12 29 13 49 14 48	9 48·7
Sun	14			1st Oc. R.	11 58	10 36·1
Mon	15					11 23·6
Tues	16	7 56 22 51	○ Full Moon Conjunction of Mars and σ Leonis, 9m.·0 E.	3rd Sh. I. " Sh. E. " Tr. I.	11 41 15 23 15 31	Saturn — 7 25·9
Wed	17					7 22·0

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Saturn
Thur	18		Sidereal Time at Mean Noon, 7 43 18·4	2nd Sh. I.	14 36	— 7 18·0
Fri	19	22 28	Conjunction of Moon and Jupiter, 2° 3′ S.	1st Ec. D.	16 7 44	7 14·1
Sat	20	13 34 14 14 13 51	Occultation of ϕ Aquarii (4½) Reappearance of ditto Conjunction of Uranus and Venus, 0° 21′ S.	2nd Ec. D. 1st Sh. I. 2nd Oc. R. 1st Tr. I. „ Sh. E.	9 33 23 13 23 14 5 14 15 15 43	7 10·1
Sun	21		Meridian passage of the Sun, 6m. 5s. after Mean Noon	1st Ec. D. „ Oc. R.	10 36 16 13 44	7 6·2
Mon	22	23 0	Moon's libration—greatest portion of the NE. quadrant visible	1st Sh. E. „ Tr. E.	10 12 11 1	7 2·3
Tues	23			3rd Sh. I.	15 42	6 58·3
Wed	24	2 32	☾ Moon's Last Quarter			6 54·4
Thur	25					6 50·5
Fri	26	12 54 13 1 13 48 13 8 13 41 13 34 14 13 13 44 14 28 14 11 15 5 14 12 16 35	Occultation, reappearance of 71 Tauri (6) Occultation of θ^2 Tauri (4½) Reappearance of ditto Occultation of θ^1 Tauri (4½) Reappearance of ditto Occultation of 80 Tauri (6) Reappearance of ditto Occultation of 81 Tauri (5½) Reappearance of ditto Occultation of 85 Tauri (6) Reappearance of ditto Near approach of Moon to B.A.C. 1391 (5) Near approach of Moon to *Aldebaran* (1)			6 46·6
Sat	27		Declination of Saturn −14° 56′ 13″	4th Oc. D. 3rd Oc. R. 2nd Ec. D 4th Oc. R. 1st Sh. I. „ Tr. I.	10 14 12 3 12 8 1 14 38 15 17 16 0	6 42·7
Sun	28	22 4	Conjunction of Moon and Uranus, 4° 59′ N.	1st Ec. D. „ Oc. R.	12 30 45 15 30	6 38·8
Mon	29	15 27	Conjunction of Moon and Venus, 4° 32′ N.	2nd Sh. E. 1st Sh. I. „ Tr. I. 2nd Tr. E. 1st Sh. E. „ Tr. E.	9 27 9 46 10 26 10 46 12 5 12 46	6 34·9
Tues	30	16 43 23 46	● New Moon Conjunction of Moon and Mercury, 2° 11′ S.	1st Oc. R.	9 56	6 31·0
Wed	31					6 27·1

THE PLANETS FOR JULY.

Mercury may be observed in the evening, at the beginning of the month, setting about an hour and a half after the Sun.

		h.	m.	s.		°	′		
1st	R.A.	8	28	58	Decl. +	19	46	Diameter	7″·3
15th	„	9	11	57	„	13	54½	„	9″·4

Venus continues to be visible in the mornings, and passes the meridian at about half-past ten A.M. at the beginning, and eleven o'clock at the end of the month.

1st	R.A.	4	59	56	Decl. +	21	52	Diameter	10″·6
15th	„	6	13	21	„	23	8½	„	10″·4

Illuminated portion of the disc of Venus, 0·942.

Mars sets shortly before eleven o'clock in the evening at the beginning of July, and about an hour and a half after the Sun at the end of the month.

1st	R.A.	10	30	9	Decl. +	10	31½	Diameter	5″·6
15th	„	11	1	0	„	7	14	„	5″·4

Illuminated portion of the disc of Mars, 0·937.

Jupiter is now coming well into view, and as his altitude is now greater, may be more favourably observed at each apparition.

1st	R.A.	22	38	28	Decl. —	9	48	Diameter	45″·8
15th	„	22	36	38	„	10	3	„	47″·0

Saturn is still a fine object in the South-West in the evenings.

1st	R.A.	15	3	56	Decl. —	14	55	Diameter	17″·4
15th	„	15	2	39	„	14	53½	„	17″·2

Dimensions of Ring—Outer Major Axis, 40″·0; Outer Minor Axis, 15″·0.

SALE OF ASTRONOMICAL INSTRUMENTS.—At the sale of Mr. Coventry's instruments, at King Street, on the 31st of May, the following prices were realised:—Lot 56, portable equatorial, by *Ackland*, 5*l.*; 57, an equatorial movement, 32*s.* 6*d.*; 66, 3-inch achromatic, by *Dollond*, unmounted, 6*l.*; 67, equatorial theodolite, by *Simms*, 17*l.* 10*s.*; 68, sidereal chronometer, by *Crispe*, 15*l.*; 69, mean time ditto, by *Appleton*, 15*l.*; 70, 1½-inch transit, by *Simms*, 6*l.*; 99, travelling microscope, by *Ross*, 5*l.* 15*s.*; 102, theodolite, by *Cary*, 2*l.* 12*s.* 6*d.*; 109, silver sidereal pocket chronometer, by *Barraud*, 11*l.*; 109*, gold tourbillon watch, by *Hunt & Roskell*, 55*l.* 10*s.*; 115, position micrometer, by *Simms*, 5*l.*; 117, 6-inch equatorial telescope, with clock-driving apparatus, by *Simms*, 100*l.*; 118, compound binocular microscope, by *Ross*, 75*l.*; 140, portable sextant, by *Simms*, 2*l.* 12*s.* 6*d.*; 143, large brass sextant, by *Simms*, 7*l.* 10*s.*; 145, 10-inch reflecting telescope, equatorially mounted, by *Browning*, 51*l.*; 146, 3-inch transit, by *Simms*, 25*l.*; 147, 4-inch achromatic, by *Merz*, of Munich, 36*l.*; 149, 3½-inch universal equatorial, by *Simms*, 42*l.*; 152, astronomical regulator, by *Barraud*, 27*l.*; 154, altazimuth, by *Simms*, 46*l.*; 196, "Cycle of Celestial Objects," by Adm. Smyth, 2 vols. 3*l.*; with a great variety of smaller astronomical instruments, all of which were of good quality, and in very good condition.

THE ANNUAL VISITATION of the Royal Observatory at Greenwich took place on the 18th of June; the weather was, however, not clear enough to allow of anything being seen with the great equatorial except a sun-spot during intervals between passing clouds.

BRIEF CORRESPONDENCE.

THE NAUTICAL ALMANAC. — I suppose your correspondent "E. B. K." consulted, by mistake, the *Nautical Almanac* for 1866, with regard to the opposition of Saturn, which is there stated to be on April 29th, 2h. 30m. I should have no hesitation as to the correctness of my supposition if "E. B. K.'s" statement of the hour (viz. 7h. 49m.) had agreed with the above. Perhaps Dietrichsen & Hannay's *Almanac* has here also to bear the blame (as at p. 133, No. 54, of the *Register*) for the implied error in the *Nautical Almanac* for 1867, the correctness of which you have, however, already sufficiently indicated by your appended note.

F. M. D'A.

BRITISH ASSOCIATION. — Where can I obtain a copy of the Sermon preached by the Rev. C. Pritchard before the Meeting of the British Association for the Advancement of Science, held in Nottingham in 1866?

Φ.

INSTRUMENTS, &c. FOR SALE.

These Notices, which are restricted to *two lines* each, are inserted free of charge to subscribers: applications respecting prices and other particulars to be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent*.—For Advertisements with prices and more complete details, a small charge will be made.

N.B.—It is particularly requested that we may be informed when instruments are disposed of, in order that the notice may be withdrawn, and fruitless applications prevented.

Achromatic Refractor, 6·4 in. ap. 8¼ ft. focus, by *Merz*, Equatorial and clockwork by *Troughton & Simms*. [73]

Achromatic Refractor, 4 in. aperture, by *Cooke & Sons*; equatorially mounted, complete in every respect. [104]

Achromatic Refractor, 4 in. ap. 5 ft. focus, by *Dollond*; equatorially mounted. Powers up to 400. [87]

Gregorian Reflector, 4¾ in. ap. 2 ft. focus, by *Dollond*, 4 powers, 50 to 200, finder, &c., on brass table stand. [63]

Achromatic Object-Glass, 4⅛ in. ap. 62 in. focus, by *Slugg*, with brass cap and receiving cell, for mounting on tube. [85]

Silvered Glass Speculum, 10⅛ in. diameter, 7 ft. focal length, of excellent quality, by *Mr. With*, in wooden tube; price moderate. [101]

Transit Instrument, 3¾ in. ap. 5 ft. focus, Ys fitted with agates for mounting on stone piers. [29]

Transit Instrument, 2¾ in. ap. 30 in focus, by *Troughton & Simms*, with micrometer eye-piece and cast-iron adjustible stand. [107]

Transit Instrument, ap. 2½ inches, by *Jones*, Charing Cross: with three circles; divided on silver. [98]

Two Equatorial Stands, for 5 ft. telescope: with circles, &c. complete. [99]

Equatorial Stand, for a 5 or 6 ft. telescope: 13 in. circles, divided on silver, to 10″ of space and 4s. of time.—Has never been used. [55]

Polar Axis, of mahogany, 7 ft. long, adapted for a 4 ft. telescope, with 12 in. circles, reading to minutes. [56]

Speculum Grinding Apparatus, capable of working a 7 ft. speculum: with tube and fittings for a 9 in. Newtonian. [57]

Recreative Science: and the first three volumes of the **Photographic Journal**: price very low. [30]

INSTRUMENTS, &c. WANTED.

Astronomical Clock, not very first-class; price low.	[65]
Equatorial Stand, for a 5 ft. Refractor: graduated circles.	[35]
Brass Tripod for a 2 ft. Telescope: condition not material.	[106]
Transit Instrument, 2 in. ap. 18 or 24 in. focus.	[71]
Transit Instrument, 1½ in. aperture, about 20 in. focus.	[102]
Monthly Notices of the Royal Astronomical Society, Vol. 3.	[26]
Monthly Notices: Vol. 5, No. 12.	[82]
Bartholomew Prescot on the Universe, published 1823: a copy wanted, in good condition.	[84]
Galbraith's Mathematical and Astronomical Tables, 2nd edition. A good price will be given for a clean copy.	[105]

LIST OF SUBSCRIBERS—Names received since our last number.

Buffham, T. H., Esq., Earith, near St. Ives, Huntingdonshire.
Elliott, Robt., Esq., Pensher House, Fence Houses, Durham.
Garnett, W., Esq., Bashall Lodge, Clitheroe.
Hedgeland, Rev. J. W., 21 Mount Radford, Exeter.
Mestayer, R., Esq., 13 Manor Road, Upper Holloway.
Shaw, W. T., Esq., 108 Bunhill Row, E.C.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June 1867.
Mead, J.

To July 1867.
Garnett, W.

To September 1867.
Buffham.
Burlingham.
Elliott.
Glover, E.
Oldfield.
Petty.
Shaw.

To December 1867.
Bates, T.
Barkas.
Briggs, Miss.
Cook, James.
Freeman, D. A.
Gooch, Miss.
Hedgeland.
Hubbersty.
Jefferies, J.
Noble, Capt. W.
Rump, H. R.
Smith, W.

To June 1868.
Welch, J. P.

NOTICES TO CORRESPONDENTS.

The Editor regrets that the publication of the present number will be unavoidably delayed for a day or two.

Corrections.—Mr. Hunt wishes us to notice that, in his letter on γ Virginis, in the last number of the *Register*, p. 136, *galley-stave heroics* ought to be between inverted commas; and, in the last paragraph, it should be deficient *of*, instead of deficient *in*, attic salt, which also should be spelt with a capital A.

Correspondents communicating with the Editor are particularly requested to notice the change in the address to Parnham House, Pembury Road, Clapton, N.E., instead of Stamford Villa, as heretofore.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 56. AUGUST. 1867.

JUPITER'S SATELLITES.

As, no doubt, many of our readers do not see the "Monthly Notices" of the Astronomical Society, it may be desirable to call their attention to the very rare phenomenon, which may be seen next month (weather permitting), of Jupiter unattended by any visible satellites. The Astronomer Royal states in the "Monthly Notices" for December 1866, that this has been observed, he believes, only twice, one of the observations being that of the Rev. W. R. Dawes. He proceeds to give the following particulars:—"On August 21, *Jupiter* will be without satellites for one hour and three-quarters; and, if the circumstances of the weather, &c. be favourable, all the four disappearances and the four reappearances may be observed in this country." The following numbers are extracted from the *Nautical Almanac*:—

1867. Aug. 21. Greenwich Mean Solar Time.	
8h. 14m.	The third satellite will enter on Jupiter's face. The Sun will not be very much depressed below the horizon, and Jupiter will not be very high, but this phenomenon may probably be seen. All these which follow may be seen well.
9h. 9m.	The second satellite will be eclipsed in the shadow of Jupiter.
9h. 28m.	The fourth satellite will enter on Jupiter's face.
10h. 4m.	The first satellite will enter on Jupiter's face.
	The four satellites will then be invisible.
11h. 49m.	The third satellite will pass off the disc of Jupiter.
12h. 13m.	The second satellite will reappear from occultation behind the body of Jupiter (its emersion from the shadow having taken place behind the body).
12h. 23m.	The first satellite will pass off the disc.
13h. 54m.	The fourth satellite will pass off the disc.*

G. H.

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* It thus appears that about half-past 10 on the 21st, the first, fourth, and third satellites, with their shadows, may be seen on the disc of Jupiter, while the second satellite is at the same time eclipsed by the shadow. On the 28th, at midnight, only one satellite, the fourth, will be visible; the first and third, with their shadows, will be on the disc, while the second will be occulted by the planet.

THE LUNAR CRATER ALHAZEN.

By W. R. Birt, F.R.A.S.

This crater has been very puzzling to selenographers on account of the protean shapes it has assumed. Sometimes it has presented the appearance of a depressed grey surface within a ring; at others, that of a longish flat ridge. Perhaps the most curious, as well as the most instructive, is that of its general *indistinctness*, while the neighbouring objects have been sharply defined—a phenomenon which I have often noticed in other cases; and this is strongly in contrast with its having been seen with extraordinary *distinctness* even when near the limb. These phenomena were recorded by Schröter at the end of the last century. In 1825 it could not be found by Kunowsky; but, in 1827, Pastorff and Harding could always see it. Köhler, in 1828, recognised it as corresponding with Beer and Mädler's Alhazen, but observed that it was *very variable* in aspect. During the progress of Beer and Mädler's survey it appears to have been missing, as they could discover no ring mountain in its place. In 1862 I found it (see 'Monthly Notices of the Royal Astronomical Society,' Vol. xxii. p. 230) to consist of two ranges of mountains that under some circumstances assumed the appearance of a crater; but I was then quite unable to detect, with an aperture of 2¾ inches, the slightest vestige of a real crater. On the 5th of July 1867, 9h. 0m. G.M.T., I saw it under very favourable circumstances with the Royal Society's achromatic of 4¼ inches aperture, power 230, Schröter's pair of craters λ and δ in its neighbourhood being very distinct (see *Astronomical Register*, No. 43, July 1866, p. 188). I then ascertained that Schröter's Alhazen is really a crater, situated on the surface between the two ranges of mountains, and but slightly depressed below it. Although not greatly depressed, it is sufficiently so to present under this illumination and visual angle the *true* crater form.

It would seem that its apparition *as a crater is rare*, probably from a variety of causes. It is quite of sufficient magnitude to have been seen with an aperture of 2¾ inches, and it would be very important to ascertain if under *nearly* similar circumstances to those of July 5, 1867, it would present a similar aspect. The selenographical conditions of its visibility on July 5 were as follows:—Morning illumination, after Perigee, 102 hours; before Apogee, 215 hours. Eastward of its mean position in longitude, Moon's latitude S. 0° 43′ 55″, a little southward of its mean position in latitude. For illumination, longitude of terminator, W. 42° 12′ 54″, angle of terminator and meridian—1° 23′. South pole of the Moon in sunlight 25 days after the winter solstice in the Moon's northern hemisphere.

On the evening of September 2, 1867, the terminator will be nearly similarly situated with regard to Alhazen, when the Sun in the Moon's northern hemisphere will be within a few days of crossing the Moon's equator at the vernal equinox. At this time, with a different angle of illumination, Alhazen will be more eastwardly of its mean position in longitude, and consequently may be seen under a greater visual angle E.—W. from the earth, the conditions being 164 hours after Perigee and 120 hours before Apogee, but it will not be so favourably situated for latitude, the Moon being about 4 degrees north of the Ecliptic.

The most favourable conditions for viewing Alhazen are clearly at equal intervals after Perigee and before Apogee, combined with the Moon's high South latitude, for then Alhazen may be seen under the greatest visual angles both E.—W. and N.–S.

Victoria Observatory, 42 Sewardstone Road West,
Victoria Park, London, N.E.: 1867, July 8.

THE LUNAR CRATER LINNE.

The Lunar Committee of the British Association for the Advancement of Science has issued "Circular No. III.," which contains a *résumé* of the observations of *Linné* that have come to hand between Dec. 12, 1866, and June 11, 1867, so far as relates to the small hill, fine black point, or small crater seen by Schmidt, Buckingham, Secchi, Respighi, and Wolf. The largest estimation (Secchi's) of the diameter of this crater previous to April 1867, viz. Feb. 11, 1867, is 0″·33, or 2,352 English feet. It appears from Respighi's communication (*Bulletin Météorologique de l'Observatoire du College Romain*, 31st May 1867) that he observed in April and May, with the equatorial of the Capitoline Observatory, Rome, by Mercz, of 4·5 inches (French) aperture, all the main features that have been recorded by Schmidt and others since 1866, Oct. 16, viz. the whitish cloud-like spot of nearly the same extent as the crater Sulpicius Gallus; the ring of a large crater of small depth, probably the ring seen by Messrs. Knott and Webb; the bright point west of the centre of the large white spot, which he found—as the English observers—to be the western border of the small crater; and the small crater itself, to which he gives a diameter of 4″·0, or 28,224 English feet. Wolf estimates the diameter at a little less than 1″·0, or 7,056 English feet. Whatever may be the truth in the midst of the conflicting *opinions* which have been expressed on the state of Linné (there are no discrepancies in the evidence), it is certain that no lunar spot has received so much attention from *so many observers* as *Linné*, and that its features are so well determined (with the exception of the diameter of the small crater, 0″·33 in February, 4″·0 in April and May, 1″·0 in June, which, by the way, are *not* contradictory,) for the early half of the year 1867, as to furnish reliable evidence of its condition at this epoch. It augurs well for the progress of selenography that so great an interest is at present being manifested in the investigation of the physical condition of the surface of our satellite, and it is to be hoped that observers will be increased, and that the most powerful instruments will be brought to bear systematically in scrutinising these conditions.

Not only is the *present* condition of Linné, as regards its main features and extent, pretty well settled, but its brightness also. In Lohrmann's time it was always (as registered by him) brighter than Conon, a crater in the Apennines of 7°. Schmidt records nine comparisons of the brightness of Linné with that of the spot on the SE. of Posidonius, marked γ by Beer and Mädler. On seven occasions he found it less bright than γ, viz. on 1866, Nov. 18, 19, 22, 23, and 24; and 1867, Jan. 13 and 14.* On Dec. 16, 1866, he recorded it equal to γ; and on Dec. 14,* 1866, it was brighter than γ. Mr. Birt also observed Linné to be less than γ on six evenings, viz. 1866, Dec. 19; 1867, Jan. 14,* 15, Feb. 11, and May 11 and 15; equal to γ on May 17, and brighter than γ on March 14. In addition, Mr. Birt made eight estimates of the brightness of Linné, as follows:—1866, Dec. 14,* 3°; Dec. 15, 3°·5; Dec. 18, 5°·5; Dec. 19, 5°; Dec. 21, 4°; 1867, Jan. 12, 3°; Jan. 14, 4°; Jan. 15, 5°. The dates marked with an asterisk (*) are common to Schmidt's and Birt's observations. From twelve observations of a brightness less than γ Posidonius, from 1866, Nov. 18, to 1867, May 15, inclusive, and four only of a different character by two independent observers, there can be no question that between 1866·88 and 1867·37 the brightness of Linné was less (slightly) than that of γ Posidonius, and from the series of estimations between 1866·95 and 1867·04 it did not exceed 5°·5 of the scale: Shadow = 0°; Aristarchus = 10°.

On Dec. 18 and 19, 1866, the brightness of Linné was determined by Mr. Birt in connection with the undermentioned objects:—

	Dec. 18.	Dec. 19.
Proclus	9°	9°
Censorinus	8·5	9
Dionysius	8	8·5
Conon	7	7
Linné	5·5	5
Bessel	4 ring.	4·5

It appears from the series of estimations that Linné *increases* in brightness as the altitude of the Sun increases.

Of the three principal features of Linné—viz. the larger crater, the whitish cloud, and the smaller crater—the cloud has been the subject of measurement. The extent of the smaller crater has been estimated.

Linné λ 11° 32′ 28″ W.; β 27° 47′ 13″ N.; α 29° 55′ 50″.
Brightness 1866·95 to 1867·04. Max. 5°·5. Min. 3°·0.

WHITISH CLOUD.

Authority	Epoch	Seconds	English feet
Schmidt	1866·794	6·90	48,688
Birt	1866·953	11·61*	81,920
Birt	1866·961	7·07*	49,886
Birt	1866·964	7·32*	51,650
Birt	1866·969	6·75*	47,627
Schmidt	1866·986	1·81	12,790
Birt	1867·636	7·95*	56,100
Buckingham	1867·197	6·00*	42,336
Wolf	1867·443	4·50	31,752

SMALL CRATER.

Authority	Epoch	Seconds	English feet
Schmidt	1866·947	0·27	1,918·4†
Schmidt	1866·983	0·24	1,695 ‡
Schmidt	1867·066	0·18	1,279 ‡
Schmidt	1867·066	0·27	1,918·4†
Secchi	1867·112	0·33	2,352
Respighi	1867·359‡	4·00	28,224
Wolf	1867·443	1·00	7,056

λ = Longitude. β = Latitude. α = angular distance from centre.
(*) The quantities marked thus are measures.
(†) Schmidt's delicate hill, or fine white peak.
(‡) Schmidt's fine black point.
1″·0 at Moon's apparent centre = 6,116·7 English feet.

Seconds of arc in English feet at Linné may be obtained thus—S representing seconds:—

$$S \times 6{,}116{\cdot}7 \times \text{Secant } 29^\circ\ 55'\ 50'', \text{ or}$$
$$7{,}066 \times \text{Secant } 29^\circ\ 55'\ 50''.$$

For facilitating computation the following logs may be useful:—

$\text{Log. } 7056 = 3{\cdot}848561. \quad \text{Log. cos. } 29^\circ\ 55'\ 50'' = 9{\cdot}937955$

the expression being $\dfrac{7056}{\text{Cos.}a}$.

Errata on p. 163, line 9: for $11^\circ\ 32'\ 5''$, read $11^\circ\ 32'{\cdot}5$; for $27^\circ\ 47'\ 2''$ read $27^\circ\ 47'{\cdot}2$.

ASTRONOMY IN AUSTRALIA.

New South Wales can hardly be expected to have contributed much hitherto to the advancement of astronomy. Seventy-eight years ago, its metropolis, Sydney, formed part of its primeval forest; in this short time its commercial progress has been rapid, and it will now probably take its place with the old countries of Europe as a contributor to arts and sciences.

The astronomical history of the colony begins in 1822, when the Paramatta Observatory was founded and supported by Sir Thomas Brisbane, then Governor of the colony. He was Vice-President of the Astronomical Society in London, but had no opportunity of contributing in any great degree to his favourite science until his appointment to the colonial government, when he perceived that an observatory would greatly tend to extend our knowledge of the southern heavens. The labours of Lacaille at the Cape of Good Hope are well known, and, under these circumstances, the observatory at Paramatta, in conjunction with those of the Cape, would have a wide field for the development of its efforts. Sir Thomas Brisbane arrived in 1821, and brought with him two assistants for the observatory—M. Carl Rümker, afterwards Director of the Hamburg Observatory, and Mr. James Dunlop. The principal instruments employed were a transit of 64 inches focal length, and 3¾ inches aperture; a 2-foot mural circle (both by Troughton); a 16-inch repeating circle by Reichenbach; and a small equatorial of 42 inches focus. The first two instruments were employed in forming a catalogue of southern stars. Various observations were taken during the six following years, and these underwent a careful reduction at the hands of Dr. Brinkley, and the honorary medals of the Royal Astronomical Society were presented to Sir T. Brisbane and Mr. Dunlop.

Encke was much assisted by the observations made by M. Rümker, when the comet which bears his (Encke's) name was traversing the southern hemisphere: it was detected at Paramatta on the evening of the 2nd June 1822.

A catalogue of 600 stars was made by Mr. Dunlop in addition to that already mentioned, and various other observations were made up to the year 1847, when the observatory was dismantled and discontinued until 1857-8, at which period a new one was erected by Mr. Scott at Sydney, and furnished with the instruments from the Paramatta Observatory. Observations were made of the great solar eclipse of March 1857, and of Donati's Comet, shortly after which Government granted 800*l.* for a new equatorial instrument.

Mr. Scott resigned his appointment in 1863, and the observatory remained in charge of Mr. Russell until 1864, when Mr. G. R. Smalley was appointed to the office.

The history of astronomy in New South Wales rests on the labours of the observatory at Paramatta and the Sydney establishment; but occasional observations have proceeded from the private observatory of Mr. Tebbutt, at Windsor, N.S.W. Here the instruments are, a transit and an equatorial refractor by Jones of 3½-in. aperture. Mr. Tebbutt is a very zealous comet-hunter, and has been the first observer of several—in addition to which his observations of others have greatly tended to confirm the elements of these bodies calculated by European astronomers. This brief notice is taken from a sketch by his pen, which concludes with a hope that before long private observatories of a high class, equal to those in the mother country and on the continent of Europe, will spring up in the Australias, to assist the national establishments in the promotion of the science.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

BIELA'S COMET.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—When an assertion is made in a well-known and popular work by an authority esteemed amongst the highest, and when that assertion is found for some unknown reason to be incorrect, I think means should be taken for pointing out the error; and when the matter relates to an astronomical discovery, I know of no better means of doing so than through your increasingly-valued publication.

Arago, in his *Astronomie Populaire,* devotes a chapter (Book xvii. chap. 8) to Gambart's Comet, as he calls it—meaning that generally known as Biela's. He gives his reasons for so calling it, which I will translate:—

" Custom has established that the periodical comets should be denoted by the names of men. This practice may excite the zeal of astronomers, and it is therefore well to keep to it; but one condition seems indispensable—viz., that the names should be selected according to invariable rules, and all self-love and natural prejudice be avoided. In the case of a periodic comet, there are three persons concerned: the astronomer who first sees it; the astronomer who first shows, by means of parabolic elements, that it had been previously observed; and he who, passing to elliptic elements, calculates exactly the duration of the revolution. Let us see what principles have prevailed for the two periodic comets (those of Halley and Encke) with which we have been occupied in the two preceding chapters.

"As to that of Halley, astronomers have decided to give it the name of the illustrious man who first occupied himself with periodical comets—who showed, by parabolic elements, that it had already appeared, proved its periodicity, and predicted its next return, which Clairaut afterwards calculated exactly.

" For the comet of Encke, they have given it neither the name of Pons, who discovered it, nor of Bouvard, who calculated its parabolic elements, but that of Encke, who noticed its preceding apparitions, and predicted its future returns.

" Why then give the name of Biela to the comet of 6¾ years, *who did nothing but discover it* (qui n'a fait que la découvrir), whilst the name of Pons has not been given to the comet which he discovered, of $3\frac{3}{10}$ years? Why have two weights and two measures? Gambard calculated the parabolic elements of the comet of 1818–19, recognised its previous apparitions, and predicted its future returns. Whilst, then, this short-period comet bears the name of Encke (which, for my part, I think very suitable), that of 6¾ years' period ought to bear the name of Gambart, not that of Biela."

Would not any one suppose, from this language, that it was an undoubted fact that Biela had merely discovered the existence of the comet, and that its theory was investigated and its orbit calculated by Gambart? Yet the actual facts are, that both those astronomers independently both discovered and determined (each from his own observations) the orbit of the comet, and showed, as was easily deduced, that it was identical with the comet discovered by Pons in 1805. Biela had an undoubted priority of ten days in the discovery (the dates being 1826, February 27 and March 9), but which first obtained with certainty the elements of the orbit is not so certain. Gambart indeed communicated his result to the *Astronomische Nachrichten* one day sooner than Biela—viz., the former writing on March 22, and the latter on March 23. But as Biela had partly expected the appearance of the comet, from the resemblance of the elements of the comets of 1772 and 1805, and also hastened to work up those of the comet he had discovered from suspecting it to be one of short period, as soon as he perceived that its motion was direct and its inclination small (though he was somewhat delayed by having no solar tables by him), there is good reason for supposing that his conclusion was arrived at some days before Gambart's. And Schumacher stated in *Ast. Nach.* 95, that he had afterwards heard from him that he had sent parabolic elements to a friend at Prague as early as March 15, and was then aware of the agreement between the elements of his comet and that of 1805.

Arago's claim on behalf of Gambart, therefore, seems to be quite untenable, and his expression about Biela being merely the discoverer of the comet's existence quite inconsistent with facts. While we allow that that illustrious astronomer must have overlooked these in some unaccountable manner, we cannot help suspecting that he was a little biassed by a similar feeling that would not suffer him to recognise the just claims of Adams in the discovery of Neptune—the feeling that Gambart was a Frenchman, and Biela was not.

I am, Sir, yours faithfully,

Greenwich: May 9, 1867. W. T. LYNN.

THE LUNAR CRATER LINNÉ.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The number of the *Bullettino Meteorologico* published by Father Secchi on the 31st ult. contains some interesting observations on the crater Linné, by Professor Respighi, the Director of the Observatory on the Capitol at Rome. He states, amongst other details, that with the equatorial by Merz of that Observatory, 4½ inches in aperture, and with a magnifying power of 250, he quickly recognised, on the evening of the 10th of April, in the white spot, and in the contiguous shadow, or small dark spot, a small, well-defined crater, almost equal in size to that of small surrounding craters. On the evening of the 9th of May, with the same instrument and magnifying power, he again saw the small crater distinctly. On the same evening he observed it with the large equatorial of the Observatory of the Collegio Romano, in company with Professor Ferrari, and they saw the small crater with the edge brighter and more raised on the western side, and the bottom completely dark. On the following evening the small crater was seen very distinctly, with the bottom completely in shade, as well with the refractor of the Capitol as with that of the Collegio Romano; and, as he had done on the preceding evening, he observed that the agitation of the atmosphere very readily rendered it confused, and caused it to disappear.

I give you Professor Respighi's deductions from his observations in his own words. Your obedient servant,

June 14, 1867. D. A. FREEMAN.

"From the whole of these observations it seems to me fairly deducible—

"1. That the great white spot is formed by a high level, probably a little raised at the edge, after the manner of a large crater.

"2. That near the western border of this high level, or of the white spot, there is a little crater of the apparent diameter of about 4″, and of not much depth.

"3. That the border and bottom of this small crater are more elevated on the western part than on the eastern, whence it follows that the crater is distinctly visible only in small elevations of the sun, and more easily after the rising of the sun than before its setting, on the horizon of the crater itself.

"4. That the brightness of the bottom, or of the white spot on which the crater is projected, contributes greatly to render its form undecided; so that the slightest atmospheric disturbance is sufficient to cause it to entirely disappear.

"With regard to the notable changes which it is asserted have taken place in this lunar crater, it seems to me that the arguments are not sufficient to prove them, as they are deduced either from observations made under unfavourable conditions, or from comparison with designs on which, in teaching of minute details, complete reliance is not to be placed.

"It is certain that Schröter, in his *Selenotopographische Fragmente*, Table IX., represents this object as a white spot, with a diameter almost equal to that of the crater Sulpicius Gallus, with a trace of a small internal crater, precisely such as is now observed, and not, as some have asserted, under the aspect of a large black spot. It is positive that the crater still exists, and of dimensions very nearly the same as those assigned to it by Schmidt himself, *i.e.* of about 4 miles in diameter.

"That if, in the lunar map of Beer and Mädler, the crater is shown as of larger dimensions, this is attributable to the want of exactness of the drawing, of which other and more manifest examples could be produced—the more so, that in this case the object treated of is represented rather by a conventional sign than by a real drawing.

"That Beer and Mädler's selection of this object as one of the fixed points of comparison of the first order in their measures, does not prove that this must be a fine crater, easily visible, but simply a well-marked and distinct object; and as such, Linné, as it now presents itself, certainly leaves nothing to be desired.

"Whence it seems to me that we may conclude that the crater either has not undergone sensible changes, or that, at least, the arguments brought forward in their favour are vague and inconclusive."

THE EARTH'S ROTATION AND MODERN GUNNERY.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The following notice appeared in a popular periodical a few weeks since:—"Our cannon are now becoming so perfect in their mechanism, that scientific men are beginning to look for the sources of error in the deviation caused by the rotation of the earth." The subject to which my attention was thus called seems suited to the pages of the *Astronomical Register*, and a matter likely to interest some of its readers. It is worthy of attention, not only as an evidence of the high skill which has been evinced by the mechanics who have devoted their attention to the perfecting of engines of destruction—assuming the truth of the quoted statement—but also on account of the train of reflection it kindles as to the possible importance of geographical position in deciding the issue of future battles, and the advantages which may depend to the artillery of one or other of the opponents, by consequence of the relative situations with reference to the equator and the poles of our globe.

A simple illustration of the effect of the earth's rotation on the trajectory of a shell may be made by attaching to the same axis two wheels of different diameters, so that both shall rotate together. If the one have a diameter of 3 feet, and the other of 1 foot, it is evident that any point on the circumference of the larger will, during a revolution, move through three times as much space as a similar point on the periphery of the lesser circle, and will, therefore, move with three times the velocity. The figure of the earth may be considered as made up of an infinite number of such wheels, diminishing in size from the equator to the poles, and all revolving in 24 hours. Now, if a gun be fired from the equator in the direction of the meridian, which is obviously that of maximum deviation, at an object nearer the pole, it is plain that that object, being situated on a smaller circle than the gun, but revolving in the same interval of time, will move, during the flight of the projectile, through less space, eastwards, than the shot, which will have imparted to it the greater velocity of the larger circle from which it started; and the latter will, therefore, tend to strike eastwards from its butt.

So far the enquiry is interesting on account of the small amount of error due to the astronomical cause, the amount at the equator being only about 7 feet in a mile. The feature which, however, I wish to bring more especially before the notice of your readers, is of the geographical aspect of the subject. One degree, of course, passes under a fixed meridian in 4m.; the difference between the length of such a degree at the equator and that of one 5,000 yards from the equinoctial line is nearly 22·8 feet; and if the shell projected from the former to the latter occupied the same interval of 4m. in its flight, this difference of 22·8 feet would be the excess of its motion over that of its billet, and the amount of its deviation; assuming the time occupied, however, to be 40s., the deviation will amount to $\frac{1}{6}$th of that amount—viz. nearly 3·8 feet. The difference between a degree of longitude at 50° from the equator, and one 5,000 yards nearer the pole, is nearly 214·3 feet, and the amount of deviation in that case is nearly 35·7 feet. It follows from this, then, that an artilleryman fighting somewhere south of Galle, Ceylon, would only be liable to one-tenth as much aberration as if warring off the Cornish coast; and a gunner of our Volunteer corps, who should have succeeded in allowing correctly for the deviation in South Coast practice, would, if suddenly called to face a foe marching from the north, be exposed to a risk of double amount of error. In all these instances it has been assumed, for the purpose of comparison, that the direction of the projectile has been parallel to the earth's axis; and it is evident that the amount of the rotation-deviation would vary in any other position, being greatest in a direction from Portsmouth to Cherbourg, and equal to *nil* in a line from Hastings to Boulogne.

In conclusion, I admit that the above figures are not perfectly accurate, extending, as will be seen, only to one place of decimals; but they are, no doubt, sufficiently so for their general object—and excessive pressure of other business has prevented me from taking into account any minute values. Such is my plea for any accidental errors the paper may contain.

I am, Sir, yours faithfully,

Streatham Hill. S. B. KINCAID.

DOUBLE STAR MEASURES.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Some of your correspondents being interested in 13 Piazzi, Hour 19, Lyræ, I send you the following measures recently got with a 6-inch lens and a power of 220, as they may be of some service in fixing the position of the smaller star *a*. I am not aware that any measures of its position and distance have yet been published.

		°	Dist.
1867·45.	A B	336·83	17·685
·A	A *a*	331·50	61·650
·B	D *a*	188·50	33·404
a·	C *a*	198·67	30·066
	A C	346·80	73·933
D · ·C	C D	293·40	5·649

other measures of	A B		C D		A C	
	°	″	°	″	°	″
Smyth	337·0	18·5	294·0	5·0	350·0	74·8
Struve	336·5	17·1	293·2	6·2	—	—
Secchi	336·4	17·7	295·4	6·3	—	—

If any of your correspondents have measured the position of the small star *a*, perhaps they would send them to you for publication in the *Register*.

I remain, Sir, yours respectfully,

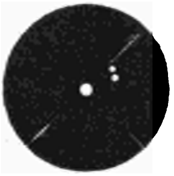
Waterloo, near Liverpool: JNO. JOYNSON.

June 29, 1867.

GAMMA 2 ANDROMEDÆ.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I send you an eye sketch of γ^2 Andromedæ, as I see it with power 600, 8-inch aperture. I have used powers 800, 1,120, and 1,400 on the object with my telescope of 9-inch aperture, by Slater, of London, but cannot present the small stars so wide asunder as represented in Mr. Dawes' diagram, in the March number of the *Register*, although I make allowance for the correction supplied by Mr. Dawes in the April number. Moreover, the small stars seem to me placed as far from the great star as they might be in Mr. Buckingham's 20-inch, or in Mr. Younge's 1h-inch diameter telescope. Mr. Knott remarked, in his letter in your March number, that "other things being equal, the separating power of a telescope depends solely on its aperture." I confess that I have very little faith in either diminishing aperture caps, or perforated zinc discs; they may give some assistance in certain states of the atmosphere, but the telescope that fails to divide a very close double star with its *full* aperture, will hardly divide it with a diminished aperture. Sir W. Herschel once observed, that it is easy to see an object when you have *once seen* it, and when you know *where* to look for it. In the observation of very close double stars, much depends upon the proper training of the eye. It is certain that the glare of a lamp on white paper, or on polished brass circles, contracts the pupil of the eye for some minutes, and unfits it at the time for the severe work of dividing a close double star. From long experience with a non-equatorial telescope, and from a pretty intimate knowledge of



the heavens, I still find all objects visible to the naked eye without having recourse to the circles, using them only for telescopic objects. I believe Sir William Herschel followed this course, and found it beneficial. I have also considered that there was much advantage in training up the eye from a low power to the highest, and in occasionally changing the eye, and using a dark leather blind before the unemployed eye. I mention these matters as mere suggestions that may be worth an experiment.

Yours truly,

St. Luke's Rectory, Manchester: W. A. DARBY.
July 15, 1867.

THE NAUTICAL ALMANAC.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—If you and your correspondents E. B. K. and F. M. D'A. had chanced to consult the *Nautical Almanac* for 1870, you would have seen in the usual list of errata of almanacs of former years, the following corrections:—"Nautical Almanac for the year 1867 (*in some copies*)—"Page 486, *for* April 29th, 7h. 49m., Saturn in opposition to Sun, *read* May 11th, 12h. 27m." "Page 487, *for* July 29th, 2h. 58m., Saturn in quadrature with Sun, *read* August 10th, 10h. 15m." This sufficiently explains the discrepancy. You and your correspondent F. M. D.'A. doubtless have *correct* copies, while E. B. K., and I too, chance to have the *incorrect* ones. My Almanac for 1867 has both the above mistakes.

Yours faithfully,

Chad Road, Edgbaston: G. HUNT.
July 6, 1867.

[The above will answer further letters we have received from our correspondents E. B. K. and T. W.—ED.]

METEOR-LIKE BODIES NEAR THE SUN.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I have no doubt but that the meteor-like bodies seen by Mr. Lowe and Mr. Bird were seeds of dandelion, which frequently float in the atmosphere to a long distance. Their direction will be found to coincide, almost invariably, with that of the wind. On June 11, while observing the planet Mercury, I noticed several of these seeds passing across the field of the telescope. The atmosphere on this day was so remarkably diaphanous, and the planet's disc so unusally distinct, that I observed, for the first time, a spot upon its surface, a little south of the centre of the planet, with faint lines diverging from it to NE. and S.

I am, Sir, yours obediently,

Uckfield: July 5. C. L. PRINCE.

THE PUBLICATIONS OF THE ROYAL ASTRONOMICAL SOCIETY.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—May I beg a little more of your valuable space, to notice the letters that have been educed by the communication which you honoured me by inserting in the June number of the *Astronomical Register?* Before doing so, however, I must be permitted to withdraw my estimate of the pecuniary value of our *Monthly Notices.* This I took at nine shillings for the nine numbers. I now find that they are sold at half-a-crown to the Fellows, and at five shillings to the public. I make a present of this emendation to the apologists for the existing state of affairs.

With reference to the letter of "A Literary F.R.A.S.," it is only needful for me to say that he sets forth very ably what is, unhappily, only too self-evident; and that is, that it is utterly hopeless to expect any reform to originate with our Council themselves; and that it is only by determined pressure from without that we can hope to obtain what we are justly entitled to.

With regard to "Another Fellow R.A.S.," I must protest, *in limine*, against his sneer at the novelty of my own Fellowship. Suppose, for argument's sake, that I only joined the Society two years ago; I must have, at all events, received two annual Reports, and am not so wholly ignorant of figures as to be incapable of deducing conclusions from the printed accounts furnished to us. Your correspondent, who seems to speak *ex cathedrâ*, accuses me of ignorance of the fact that the Council have already tried to distribute our *Transactions* amongst the Fellows; but have been "deterred on account of the expense attending it." He appears to be in some way behind the scenes. Will he tell us, through your columns, when and how the Council arrived at this decision, and also whether they are "deterred on account of the expense attending it" from absolutely giving away some two hundred copies!!! of those *Memoirs*, which they insist upon us (at whose cost they are printed) paying for? I am rather amused at the argument that the circumstance of very few copies of the *Memoirs* being sold "is sufficient to show that the *Notices* supply the wants of a large majority." As far as I am concerned, many parts of the *Memoirs* would be of the greatest possible use to me; but I absolutely decline to pay twice over for them, and I believe that a very large proportion of my brother Fellows abstain from purchasing them for the same reason. It is by no means the fact that the bulk of our *Transactions* is made up of "the numerical results of observations" and "mathematical investigations;" and besides, if my memory serves me, I have seen a fair proportion of a number of the *Monthly Notices* occupied by symbols and formulæ before now. "Another Fellow, R.A.S.," accuses me of "personality." This must, I think, refer either to what I have said touching the medals and the reduction of observations, or to the editorship of the *Monthly Notices*. My comments on the first two items of expenditure had strict reference to the subject under discussion; my argument being, that if we were so very poor as to be only able to give five shillings' worth of publications in return for a two-guinea subscription, we had no business to be wasteful in other ways. I found, on reference to No. 4 of vol. 27 of the *Monthly Notices*, that fifty pounds had been paid for reducing Sir William Herschel's observations. Knowing something of computation, I thought this monstrous. Perhaps "Another Fellow, R.A.S.," (who is apparently in the confidence of the Council) will tell us who made such a charge, and whether it was ever demurred to? If a man were persistently to entreat the indulgence of his tradesmen, and express his utter inability to pay their long outstanding bills, at a time when he was entertaining his own private friends with ortolans, apricot tart, and Roederer champagne, I should think him a little inconsistent—that's all.

Reference to the Editorship of the *Monthly Notices* brings me to the letter of Mr. Baxendell. I deny, *in toto*, that I have made any "attack, unwarrantable" or otherwise, against Mr. Cayley, in his capacity of a Member of Council. The charges I bring against him are as against our paid servant (which he is, just as much as Mr. John Williams). Possibly Mr. B. is a personal friend of his, and may have some special and peculiarly early copy of the *Notices* sent to him. I can only say that *I* have not; and it is a subject of loud and general complaint among the country Fellows that they rarely, if ever, receive the report of one meeting in time for the next. Now there is a tradition among those who joined the society in years past, that once upon a time, most happily, Mr. Carrington, the great sun observer, edited the *Monthly Notices*; and it is alleged that not only did they then contain extracts of astronomical interest from the *Astronomische Nachrichten*, and other external sources of information, but that they were always brought out three weeks, and sometimes even a fortnight, after the meeting at which the papers they contained were read. What Mr. Carrington has done, Mr. Cayley can do. "Birds that can sing and won't sing" . . . (your correspondent can supply the rest of the proverb). With regard to the demand for my name, I am not so fond of parading it in print as Mr. Baxendell seems to be of seeing his. When he has shown that the dilatoriness and apathy of which I accuse Mr. Cayley are unfounded, it will be time enough for him to ask me to manifest my identity. Meanwhile, I utterly deny his "right"—or that of anybody else—to know more than that I am really what I subscribe myself,

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

July 8, 1867.

REFRACTION ACCORDING TO "N."

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Your correspondent "N." is less at issue with me than with himself.

After favouring us with a familiar illustration of refraction, drawn from the properties of a thick pane of plate-glass, he remarks: "So that external objects invisible with the window open, would be easily seen if the window be shut!"

The obvious reply to his note of interjection is, that if the objects external to a window of plate-glass be, with the eye, placed at the same relative angles as in his own experiment, the result would be the same. Nothing is easier, with a plate-glass window, or with a window containing knotted or starred panes, than so to place any outside object that it shall be hidden when the window is open, and (with the eye at the same level) brought into sight when the window is closed.

The atmosphere may be treated as a thick pane of glass between us and the sun, with a convex outer surface, like that of the cornea, or the object-glass of an achromatic telescope. Were it removed, so that light would reach us at all angles, without any change of divergence or convergence from its original direction, we should in no case see an image of the sun before the sun itself is above the horizon; there would be no twilight, and even our daylight would be different from what it now is. Whether, under such circumstances, the eye could collect a sufficient amount of illuminative power to project on its retina the stars as distinct points, is the question I have raised.

Thus much in the way of further explanation to set myself right with your readers. They will require no aid from me to judge of the propriety of the tone adopted by your correspondent, while withholding his name, and admitting the juvenility of his own experience.

Your obedient servant,

W. E. HICKSON.

Fairseat, Wrotham:
July 7, 1867.

THE DUSKY RING OF SATURN.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—My attention has been called to a very serious mis-statement on p. 129 of my *Descriptive Astronomy*, which, in justice to one concerned, I desire to rectify without delay.

On the said page a paragraph runs as follows:—"On December 3, Lassell, while on a visit to Dawes, saw 'something like a crape veil covering a part of the sky within the inner ring.' This observation, *it would seem, was not made in consequence of any hint given by Dawes* as to what he himself had seen, so Lassell must be regarded as a third, or, reckoning Galle, a fourth independent discoverer."

I have satisfied myself that the passage italicised is entirely the reverse of the truth, and that Mr. Lassell has no claim to be regarded as an independent discoverer. I was misled by depending on the *Monthly Notices* of the period, and by the phraseology adopted by Mr. Lassell in communicating to the society his account of certain observations made by him in company with Mr. Dawes.

Your obedient servant,

Junior Carlton Club, London:
June 5, 1867.

GEORGE F. CHAMBERS.

COMET II. 1867.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The following ephemeris, by Bruhus, of Leipzig, has just reached me:—

1867. August.		R.A. h.	m.	s.		Decl. °	′
2	...	16	10	10	...	20	16·7
6	...	16	17	39	...	21	0·1
10	...	16	25	18	...	21	40·8
14	...	16	33	12	...	22	18·6
18	...	16	41	16	...	22	53·6
22	...	16	49	32	...	23	25·7
26	...	16	57	55	...	23	54·8
30	...	17	6	26	...	24	21·2

The comet is departing both from the Sun and the Earth. I reserve for a future letter some remarks on its short period and orbit generally.

Your obedient servant,

Gordon Lodge, Bickley:
July 27, 1867.

G. F. CHAMBERS.

The Memoirs of the Royal Astronomical Society.—We understand that the Council of the Royal Astronomical Society have resolved that in future the Memoirs of the Society shall be given to all Fellows applying for them, and that this regulation will commence with the volume preparing for the current year. The subject has occupied the attention of the Council on several occasions before, but the expense was considered too great. Thanks, however, to a more energetic management, and the gentle pressure from without of which our pages have been the medium, this act of justice is now accomplished, on which we heartily congratulate the Fellows of the Society.

ASTRONOMICAL PRONUNCIATION.

The following is offered as the commencement of a list of words, in answer to F. B. (*Astronomical Register*, No. 51, p. 67):—

Adāra
Alcmēna
Aldebaran* (*Al-debarán*) pronounced Ad-debarán
Alderāmin
Alcy̆ŏne
Algenib (*Al-jánib*)
Algerab (*Al-gheráb*)
Algol (*Al-ghúl*)
Almagést (Arabic article *al*, and Greek *magistus*, greatest)
Alphĕrat
Altair (*Al-táir*, pronounced at-táir)
Antĭnŏus
Antĭŏpe
Apsīdes
Arātus
Archimēdes
Archy̅tas
Asterŏpe
Aurīga
Autoly̅cus
Beātrix
Bellātrix
Betelgenæ or Betelgeúze (ibt-al-jauza)
Boōtes
Callĭŏpe
Canes benātĭci
Canōpus
Cassiopēa
Celēno
Censorīnus
Centrifŭgal
Centripĕtal
Circĭnus
Circumpŏlar
Cleomēdes
Cleostiătus
Clepsy̆dra
Cly̆tic
Collimăter
Corna Berenīces
Cy̆bĕle
Dănăē
Delphīnus
Denebŏla
Diōne
Ĕcho
Egĕrĭa
Encĕlădus
Erăto
Eridănus
Etānin (Rás-al-tannín: it should therefore be pronounced el-tannin)
Euclīdes
Euphrosy̆ne
Eury̆dĭce
Eury̆nŏme
Facŭlæ
Fomalhaut (fom-al-hút)
Galatēa
Găny̆mēde
Gibbeus (g hard)
Harpălus
Hēlĭacal
Hĕlĭcon
Hēliocentric
Hēliomĕter
Heraclīdes
Hēsĭŏdus
Hespĕria
Hippălus
Hy̆ădes
Hy̆geia
Hygīnus
Hyperbŏla
Hypĕrīon
Irēne
Japŏtus
Leucŏthĕa
Lucŭlus
Magīnus
Mamoly̆cus
Mĕlĕte
Melpŏmĕne
Mercātor
Mĕrŏpe
Monocĕros
Nĭŏbe
Orīon
Panŏpea
Parabŏla
Parthĕnŏpe
Phocylĭdes
Phōsphŏrus
Phōtosphere
Præsēpe
Procy̆on
Raselgóti (Ras-al-jathi)
Retĭna
Sĕmĕle
Sheratán (Sharataïn)
Sīrius†
Stĕrŏpe
Străbo
Syzĭgy
Tálitha (al-thálitha)
Tāy̆gŏta
Terpsichŏre
Thalīa
Thĕmis
Timochăris
Urănĭa
Urănus
Vindemiātrix
Xenŏphănes

---

* *Al*, in this and many other names, is the Arabic article. The Arabic names in our maps and globes are so corrupt that it is almost useless to attempt to indicate their proper pronunciation. See, for example, Betelgeux, where the Arabic name is given from Smyth's 'Cycle.' The English equivalents to the Arabic names are carefully and accurately given in the 'Cycle,' but it would be an improvement in the new edition if the original Arabic were also added.

† The first syllable is in fact *ei*; but it would be rather an affectation to alter the usual pronunciation, nor does it much matter whilst custom has sanctioned such flagrant deviations from accuracy as in the ordinary pronunciation of *amazon*, *cyclopædia*, for example.

ASTRONOMICAL OCCURRENCES FOR AUG. 1867.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h m
Thur	1		Sidereal Time at Mean Noon, 8 36 30·8			Jupiter — 13 50·5
Fri	2	17 16 19 38 22 34 23 16	Inferior Conjunction of Mercury Conjunction of Mars and β Virginis, 0m.·6 E. Occultation of Mars Reappearance of ditto			13 46·1
Sat	3	0 4 2 39	Conjunction of Moon and Mars, 0° 21′ S. Conjunction of Mars and χ Virginis, 0° 4′ N.	3rd Ec. D. 2nd Ec. D. 3rd Oc. R.	9 35 51 14 42 43 15 24	13 41·8
Sun	4	8 0	Moon's libration—greatest portion of the NW. quadrant visible	4th Sh. I. 1st Ec. D.	14 3 14 25 23	13 37·5
Mon	5		Meridian passage of the Sun, 5m. 47s. after Mean Noon	2nd Sh. I. „ Tr. I. 1st Sh. I. 2nd Sh. E. 1st Tr. I. 2nd Tr. E. 1st Sh. E. „ Tr. E.	9 10 10 13 11 40 12 4 12 11 13 4 13 59 14 30	Moon. — 4 39·3
Tues	6	19 9	☽ Moon's First Quarter	1st Ec. D. „ Oc. R.	8 54 7 11 41	5 25·8
Wed	7	0 22	Conjunction of Moon and Saturn, 2° 34′ S.	1st Sh. E. „ Tr. E.	8 28 8 56	6 11·9
Thur	8					6 58·2
Fri	9					7 44·9
Sat	10	0 17	Conjunction of Venus and Mercury, 4° 36′ S.	3rd Ec. D.	13 36 48	8 32·1
Sun	11			1st Ec. D.	16 20 7	9 19·5
Mon	12	5 3	Conjunction of Mars and η Virginis, 8m.·5 E.	2nd Sh. I. „ Tr. I. 1st Sh. I. „ Tr. I. 2nd Sh. E. „ Tr. E. 1st Sh. E. „ Tr. E.	11 48 12 30 13 34 13 54 14 42 15 21 15 54 16 14	10 7·0
Tues	13			1st Ec. D. „ Oc. R.	10 48 53 13 25	10 54·3
Wed	14	22 37	○ Full Moon	1st Sh. I. „ Tr. I. 3rd Tr. E. 2nd Oc. R. 1st Sh. E. „ Tr. E.	8 2 8 20 8 33 9 59 10 22 10 39	11 41·2
Thur	15	11 54 12 52 23 7	Occultation of e^1 Aquarii (6) Reappearance of ditto Conjunction of Moon and Jupiter, 2° 20′ S.	1st Oc. R.	7 51	12 27·6

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Jupiter —
Fri	16		Sidereal Time at Mean Noon, 9 37 38·5			12 44·9
		8 51	Occultation, reappearance of λ Aquarii (4)			
		9 35	Near approach of Moon to 78 Aquarii (6)			
		13 22	Occultation of 81 Aquarii (6)			
		14 5	Reappearance of ditto			
		14 19	Occultation of 82 Aquarii (6)			
		15 29	Reappearance of ditto			
		17 23	Conjunction of Jupiter and σ Aquarii, 0m.·9 W.			
Sat	17	12 34	Near approach of Moon to 20 Piscium (6)			12 40 5
Sun	18	14 55	Conjunction of Jupiter and σ Aquarii, 0° 5′ N.			12 36·1
Mon	19		Meridian passage of the Sun 3m. 30s. after Mean Noon	**2nd** Sh. I.	14 26	12 31·7
				„ Tr. I.	14 46	
				1st Sh. I.	15 28	
				„ Tr. I.	15 38	
Tues	20	21 20	Greatest westerly elongation of Mercury, 18° 26′	**1st** Ec. D.	12 43 47	12 27·2
				„ Oc. R.	15 9	
Wed	21	10 4	Jupiter without a satellite	**3rd** Sh. I.	7 44	12 22·8
				„ Tr. I.	8 14	
				4th Sh. I.	8 17	
				2nd Ec. D.	9 9 47	
				4th Tr. I.	9 28	
				1st Sh. I.	9 57	
				„ Tr. I.	10 4	
				3rd Sh. E.	11 23	
				„ Tr. E.	11 49	
				2nd Oc. R.	12 13	
				1st Sh. E.	12 16	
				„ Tr. E.	12 23	
				4th Sh. E.	12 59	
				„ Tr. E.	13 54	
Thur	22	9 22	☾ Moon's Last Quarter	**1st** Oc. R.	9 35	12 18·4
		14 39	Occultation of 48 Tauri (6)			
		15 45	Reappearance of ditto			
		16 46	Occultation of γ Tauri (4)			
		18 0	Reappearance of ditto			
Fri	23					12 14·0
Sat	24					12 9·6
Sun	25	9 5	Conjunction of Moon and Uranus, 5° 1′ N.			12 5·1
		19 25	Opposition of Jupiter			
Mon	26					12 0·7
Tues	27	22 33	Conjunction of Moon and Mercury, 3° 16′ N.	**1st** Oc. D.	14 34	11 56·2
				„ Ec. R.	16 54 18	
Wed	28	13 33	Conjunction of Moon and Venus, 2° 51′ N.	**3rd** Tr. I.	11 29	11 51·8
				2nd Oc. D	11 34	
				3rd Sh. I	11 45	
				1st Tr. I.	11 47	
				„ Sh. I.	11 51	
				„ Tr. E.	14 6	
				„ Sh. E.	14 11	
				2nd Ec. R.	14 31 14	
				3rd Tr. E.	15 5	
				„ Sh. E.	15 24	

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	
Thur	29	 1 5	Eclipse of Sun, invisible at Greenwich ● New Moon	1st Oc. D. „ Ec. R. 4th Oc. D.	9 0 11 23 2 14 51	11 47·4
Fri	30			1st Tr. E. „ Sh. E. 2nd Tr. E. „ Sh. E.	8 32 8 39 9 1 9 16	11 43·0
Sat	31	16 45	Conjunction of Moon and Mars, 2° 24′ S.			11 38·5

THE PLANETS FOR AUGUST.

Mercury arrives at inferior conjunction on the 3rd; he will be well situated for observation before sunrise about the 24th of the month.

	h.	m.	s.		°	′		
1st R.A.	8	51	0	Decl. +	12	33	Diameter	11″·4
15th „	8	30	11	„	16	34	„	9″·0

Venus may also still be seen in the morning, but her distance from the Sun is now rapidly decreasing.

1st R.A.	7	43	9	Decl. +	21	46½	Diameter	10″·0
15th „	8	55	1	„	18	21½	„	9″·8

Illuminated portion of the disc of Venus, 0·981.

Mars may still be seen for a short time in the evening after sunset.

1st R.A.	11	39	1	Decl. +	2	58½	Diameter	5″·0
15th „	12	10	58	„ −	0	39½	„	5″·0

Illuminated portion of the disc of Mars, 0·956.

Jupiter will now be very well situated for observation: a curious and rare occurrence, the apparent absence of all the satellites, may be observed on the 21st if the weather prove clear.

1st R.A.	22	31	28	Decl. −	10	38	Diameter	48″·8
15th „	22	25	23	„	11	16	„	49″·6

Saturn may be well observed in the evenings: the planet sets about three hours after the Sun, more or less, during August.

1st R.A.	15	2	46	Decl. −	14	58½	Diameter	16″·8
15th „	15	4	16	„	15	8½	„	16″·4

Dimensions of Ring—Outer Major Axis, 37″·0; Outer Minor Axis, 14″·0.

Études sur L'Astronomie Indienne et Chinoise, par J. B. Biot. Paris, 1862. (Williams & Norgate, London.)

A very valuable and interesting work by the late well-known astronomer Biot, assisted in his researches by some of the first Orientalists in France. No one who has occasion to take up, however briefly, the history of astronomy in India and China, ought to be unacquainted with the patient, long-continued, critical investigations and lucid arguments of M. Biot. The work was completed in his 87th year.

BABYLON.—The expansive plains of Babylonia possess such natural advantages for the study of astronomy, that we cannot wonder at their having become the birthplace of that science. The remarkable dryness and regularity of the climate, the serenity of the sky, and the transparency of the atmosphere, particularly point to that region as admirably adapted to studies and investigations of this nature. Constellations (stars ?) of the eighth magnitude are distinctly visible to the naked eye; while between May and November, meteors fall in countless numbers. Under these circumstances, when observatories are being established in various less favourable localities, it appears not a little strange that "the land of the Chaldees" is passed over in utter forgetfulness. With the appliances and correctly-adjusted instruments which the march of civilisation has produced, what additions to our knowledge of astronomy and meteorology might we not attain by erecting an observatory at such a spot as Bághdád or Babylon!—Loftus's *Researches in Chaldeæ*, p. 32.

LUNAR MAPS.—Mr. Birt has just issued two lunar maps, in *red* outline, with all the present known objects marked, in order that gentlemen who find any variation in the objects may mark them in *black*. These maps, which contain 203 objects, are on a scale of 200 inches to the moon's diameter, and comprise the space included between 0° and 6° West longitude, and 0° and 10° South latitude.

INSTRUMENTS, &c. FOR SALE.

These Notices, which are restricted to *two lines* each, are inserted free of charge to subscribers: applications respecting prices and other particulars to be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent*.—For Advertisements with prices and more complete details, a small charge will be made.

N.B.—It is particularly requested that we may be informed when instruments are disposed of, in order that the notice may be withdrawn, and fruitless applications prevented.

Achromatic Refractor, 6·4 in. ap. 8½ ft. focus, by *Merz*, Equatorial and clockwork by *Troughton & Simms*. **[73]**

Achromatic Refractor, 4 in. aperture, by *Cooke & Sons*; equatorially mounted, complete in every respect. **[104]**

Achromatic Refractor, 4 in. ap. 5 ft. focus, by *Dollond*; equatorially mounted. Powers up to 400. **[87]**

Gregorian Reflector, 4¾ in. ap. 2 ft. focus, by *Dollond*, 4 powers, 50 to 200, finder, &c., on brass table stand. **[63]**

Achromatic Object-Glass, 4⅛ in. ap. 62 in. focus, by *Slugg*, with brass cap and receiving cell, for mounting on tube. **[85]**

Silvered Glass Speculum, 10⅛ in. diameter, 7 ft. focal length, of excellent quality, by *Mr. With*, in wooden tube; price moderate. **[101]**

Transit Instrument, 3¾ in. ap. 5 ft. focus, Ys fitted with agates for mounting on stone piers. **[29]**

Transit Instrument, 2¾ in. ap. 30 in focus, by *Troughton & Simms*, with micrometer eye-piece and cast-iron adjustible stand. **[107]**

Equatorial Stand, for 5 ft. telescope: with circles, &c. complete. **[99]**

Equatorial Stand, for a 5 or 6 ft. telescope: 13 in. circles, divided on silver, to 10″ of space and 4s. of time.—Has never been used. **[55]**

Polar Axis, of mahogany, 7 ft. long, adapted for a 4 ft. telescope, with 12 in. circles, reading to minutes. **[56]**

Speculum Grinding Apparatus, capable of working a 7 ft. speculum: with tube and fittings for a 9 in. Newtonian. **[57]**

Recreative Science: and the first three volumes of the **Photographic Journal**: price very low. **[30]**

INSTRUMENTS, &c. WANTED.

Astronomical Clock, not very first-class; price low.	[65]
Equatorial Stand, for a 5 ft. Refractor: graduated circles.	[35]
Brass Tripod for a 2 ft. Telescope: condition not material.	[106]
Transit Instrument, 2 in. ap. 18 or 24 in. focus.	[71]
Transit Instrument, 1½ in. aperture, about 20 in. focus.	[102]
Monthly Notices of the Royal Astronomical Society, Vol. 3.	[26]
Monthly Notices: Vol. 5, No. 12.	[82]
Bartholomew Prescot on the Universe, published 1823: a copy wanted, in good condition.	[84]
Galbraith's Mathematical and Astronomical Tables, 2nd edition. A good price will be given for a clean copy.	[105]

BRIEF CORRESPONDENCE.

JUPITER'S SATELLITES.—Have the Moons of Jupiter ever been under spectrum analysis; and should such have been the case, what has been the result? H. J.

DENSITIES OF THE ASTEROIDS.—Permit me to ask if any of the readers of the *Astronomical Register* can oblige me by giving the name of any work in which the mean densities of the asteroids are estimated, or in which any attempt has been made to ascertain their mean densities? I am desirous of knowing if the increase of mean density proceeds with the diminution in size, as is substantially the case from the Sun to Mercury, and if so, on what theory the increase can be accounted for.

T. P. BARKAS.

In reply to ϕ, the Sermon by the Rev. C. Pritchard is published by Bell & Daldy, 186 Fleet Street.

Mr. W. Lawton has sent us a Meteorological Register for 1866, taken at 8 Manor House Street, Hull, giving, in a plain and concise manner, the readings of the barometer and thermometer, the rainfall, &c. for the year.

LIST OF SUBSCRIBERS—Names received since our last number.

Clarke, James S., Esq., Vernon Street, Derby.
Dawson, A., Esq., The Cedars, Chiswick, W.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1867.

Anthony, J.
Clarke, J. S.
Compton, A.
Coulcher, W. M.
Court, J.
Dawson, A.
Dell, T.
Jackson, Mrs.
Lawton, W.
Lee, J.
Prince, C. L.

July 16, 1867.

NOTICE TO CORRESPONDENTS.

Several communications have been received too late for this number.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 57. SEPTEMBER. 1867.

THE HUNDREDTH PLANET.

By W. T. Lynn, Esq., B.A., F.R.A.S.

Professor C. H. F. Peters, of Hamilton College Observatory, Clinton, has detected another small planet, the sixth of his discoveries, counting from Feronia, which he was the first to observe.

He succeeded in obtaining a place of this, the only planet hitherto found in the present year, just before daybreak on the 8th of July, or, in astronomical reckoning, 1867, July 7d. 15h. It was quite equal in apparent brightness to a star of the eleventh magnitude.

This discovery is somewhat noteworthy, as completing the number of one hundred known primary planets in our solar system. In the time of our great poet Milton there were but six, the earth itself and those bodies which he supposes our first parents to apostrophize as—

> Ye five other wand'ring fires that move
> In mystic dance——

All these were known to the ancients, although their true position in the universe was not recognised until the labours of Copernicus, Galileo, Kepler and Newton, had placed astronomy on a sure and indestructible basis. Planetary discovery began in 1781 with Uranus, and a second large member was added to the known list in 1846. But prior to the latter date the detection of the large group of asteroids, or (as they are now usually called) minor planets, had commenced. On January 1, 1801, Piazzi discovered the first of these, and, as I have said, on July 7, 1867, Peters discovered the ninety-second. It will be seen that I do not take into account in my numeration of one hundred planets the supposed planet within the orbit of Mercury. The fact that it has not been seen, notwithstanding the diligent searches made since its supposed discovery by Lescarbault, may well make us hesitate to accept its existence as a fact; and this doubt is certainly increased by M. Liais' scrutiny of the sun's disc at the time.

It will be, I think, not uninteresting to compare the dimensions of the largest and smallest, so far as they have been determined, of the hundred planets now recognised as revolving round the sun. In the last number of the Monthly Notices of the Royal Astronomical Society, Mr. Stone has furnished values of the diameters of a very large proportion of the minor planets. Of these the smallest is Echo (No. 60), whose diameter is only 17 miles. The most recent determination of the value of that of Jupiter (see Chambers's *Descriptive Astronomy*) is 88,390 miles. It will follow that the cubical contents of the globe of Jupiter is about 361,582,917,000,000 miles, whilst that of Echo is only 2,572 miles. Consequently, the former planet would contain the latter about 140,000 millions of times.

THE AUGUST METEORS.

THE display of meteors on the evening of the 10th of last month was comparatively small; the circumstances, however, were not very favourable for observing any but the larger ones, owing to the moonlight. From 10 o'clock until about 2 o'clock in the morning meteors were occasionally seen, but nothing in any way approaching the magnificent display of November last. Mr. Lucas, at the Radcliffe Observatory, Oxford, recorded 85 from half-past 10 up to 3 o'clock in the morning, the greatest number in one time being 17, from 12 to 1 o'clock. Most of them came from points near β Pegasi and β Cassiopeiæ. Mr. F. Bird, of Birmingham, says that the display was sufficiently marked to show that meteors in considerable numbers were coming in from space. He observed and recorded 23 between 10 o'clock and a quarter-past 1. Mr. Vivian, at Torquay, considered that from 10 to 20 per hour fell during the night, mostly radiating from near the sword handle of Perseus. Mr. Wood, of Birmingham, observed them from the 8th until the 11th of August; he gives the numbers per hour as on the 8th, 6; on the 9th, 10; on the morning of the 10th, 14; on the night of the 10th, 7; on the morning of the 11th, 6: the *maximum* occurring on the morning of the 10th. Mr. G. C. Thomson, of Cardiff, observed, however, a much larger number per hour, obtained from two quarter hours' average; he gives the number at 134, but he thinks the meteors were neither so large nor attended by such brilliant trains as those of last year. He considers the radiant point to have been situated in R.A. 3h. and North Dec. 54°. Mr. G. J. Walker, of Teignmouth, says, "The

August meteors seem to have 'missed fire' this time, at least in our hemisphere. I waited until 2 A.M. two nights to look out, but saw very few. Most of them seemed to radiate from the sword handle of Perseus, as usual."

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I beg to inform you that, between midnight and 1h. A.M. on the 11th inst., I observed sixteen meteors, with a well-indicated radiant, in Cassiopeia, near the right elbow of Perseus. At 0h. 30m., Dublin time, a very remarkable one, issuing from a point in 40° R.A. and 31° N.P.D., moved about a quarter of a degree to the left, and then returned to almost the precise spot whence it started, where it remained stationary for many seconds. At 0h. 35m. a meteor nearly as large as Jupiter passed close under *o* Ursæ, and another, like a bright second-magnitude star, from near the radiant towards δ Persei.

Most of the meteors were tail-less, and of a scant cindery aspect, like those of the December shower, though this appearance might be partly due to the strong moonlight. Some, however, had fine full discs and long tails like the November group, but differed from the latter in showing but a single colour, which, in nucleus and train alike, was a deep orange. Had there been no moon, these would probably have appeared superior to any of the November display.

Your obedient servant,
JOHN BIRMINGHAM.

Kingstown, Dublin:
August 15, 1867.

THE PLANET JUPITER WITHOUT HIS SATELLITES.

OBSERVED BY THE EDITOR AND MR. H. PERIGAL, JUN.

THE evening of the 21st of August was looked forward to with much anxiety by most observers in the hope of seeing the rare phenomenon of "Jupiter without a satellite." It is an observation seldom to be made; the last instance was in 1843, when, on the 27th of September, Mr. Dawes observed the planet for thirty-five minutes without his satellites.

On the present occasion, to which the Astronomer Royal had some time ago called attention, the weather was very tantalising: and at 8 o'clock in the evening there was no appearance of Jupiter, owing to the cloud and mist which extended upwards from the horizon to a considerable distance. It was shortly before 10 o'clock that we first got a view of the planet, and at that time the first satellite was observed about to disappear at the following limb. No other satellite was visible, and the state of the atmosphere was such that scarcely anything could be made out on the disc of the planet. Our hopes were alternately raised and depressed by the passing clouds and mist, but at length we were rewarded with occasional very excellent views of the planet. At a few minutes past 10 the first satellite had disappeared, and the phenomenon of "Jupiter without his satellites" was in full view. The telescope (3⅝ in. aperture) was now armed with a power of 100, and two black dots were soon seen on the upper (or south) belt. A closer scrutiny in the intervals of cloud, with an improving atmosphere, speedily revealed another black dot, which, with the other two, were of course ascribed to the three shadows (of the 1st, 3rd, and 4th satellites), the other satellite being in the shadow of Jupiter. Shortly an exclamation was made that there were four black dots, and a little while after Mr. Perigal saw five! This was at a quarter to 11, at which time the clouds closed over the planet, and in spite of continued watching and patience, nothing more was seen.

The observation of the five black dots showed that the somewhat anomalous occurrence had taken place of the third and fourth satellites appearing as black bodies on the disc of Jupiter. This is a matter not entirely accounted for, but its occasional occurrence is well ascertained. In March 1861 it was very frequently observed: the editor of the *Register* noticed it repeatedly, and it was the subject of communications to the *Times* as well as to the Monthly Notices of the Royal Astronomical Society. It was frequently the case that the satellites, on being first observed, were mistaken for their shadows. In the present instance the observation was unique; Jupiter was actually seen with five black spots on his disc, and the appearance of these black spots seen projected on the line of the belts was aptly compared to a bar of printed music! At the time our observation concluded, the third satellite, preceded by its shadow, was approaching the preceding limb of the planet: the shadow was intensely black, the satellite of a much fainter, somewhat greyish tint. The shadow of the fourth satellite was large and dark, and very near the centre of the disc, the satellite itself being about ¼th of the planet's diameter from the following limb, and as black in appearance, although not so large, as its shadow. At the same time the shadow of the first satellite was seen directly below the fourth; but the first satellite we did not detect on the body of the planet, the uncertain state of the atmosphere being against any observation of a very careful character. The satellites and their shadows were all projected on the southern central belt of the planet, with the exception of the fourth satellite, which was seen upon a narrow belt just south of that which the others occupied. We hope that others have been more successful in observing and recording the particulars of a most interesting occurrence, and we cannot conclude without tendering our thanks to the Astronomer Royal and others who have drawn attention to it.

Clapton: August 22nd, 1867.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Having been favoured with a fine view of Jupiter last night, from about 9 o'clock to 1, I thought some particulars might be acceptable to the readers of the *Astronomical Register.* The immersion of the second satellite in eclipse, and the transit of the third, were unfortunately not seen on account of Jupiter being hidden by some trees. The passage of the fourth satellite on to the disc was watched and well seen, though not much was made out, on account of the tremulous state of the air. The shadows of the two satellites were both very plain, and that of the third looked much the larger. The last satellite went on just about the calculated time, 10 4; and at 10 30, the atmosphere having become steadier, all the three satellites were visible, as black spots, as well as their shadows. The first very soon disappeared, and at no time after could I at all see it. Can the dark appearance of the satellites on the disc be explained? They seemed to me to be almost as dark as the shadows. The aspect of the planet was now very strange, and I noticed a curious little bay in the under edge, upper segment, of the under broad belt, which showed the rapid rotation of the planet admirably. The way in which the shadow of the first satellite caught up that of the fourth and passed it, was very interesting.

The third satellite was no longer visible at about 11 15, and its shadow went off at 11 24, the notched appearance of the edge being very curious. The satellite itself was nicely off the disc at 11 52, and then it seemed to me as if there was a little depression on the edge of the planet just where the satellite had come out. This I suppose to have been the effect of the closeness of the discs. The satellite seemed much brighter than the limb, and the contrast with the black spot it had been was very striking.

At 12 53 the shadow of IV. was just notching the disc, and III. and I. formed a fine pair.

Hoping some more able observer will let us know of any phenomena of interest he may have witnessed, I am, Sir, yours truly,

York: August 22, 1867. THOS. H. WALLER.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—There seems little doubt that you, being a herald of Astronomy, will forgive my sending you a few notes of the interesting facts which took place last evening, as computed and known to most of the readers of the unique *Astronomical Register.* A bank of clouds prevented observation at the first part of Jupiter's satellites' disappearing to the owner of "Der mond observatory;" but at favourable times, first three of his moons only were seen, then two, then one: and at last he was observed without any beyond his disc. For a considerable time two of the satellites were viewed here, which appeared like two darkish spots on the upper belt of the planet. Telescope used, one of Dollond's, 4¼-inch object glass, power of eye-piece 92.

Believe me, yours faithfully,

Hereford Square, S.W.: H. JACKSON.
August 22, 1867.

(*Extract of a letter from Mr. F. Bird.*)

"The planet emerged from the Birmingham smoke somewhere about half-past eight. I directed my small achromatic to it, and perceived three satellites near the disc—two on the eastern and one on the western side. It was not until nine o'clock the planet came within range of my larger telescope—a silvered-glass reflector, 12-in. aperture. On directing this telescope to Jupiter, the three satellites were well visible—namely, the 1st, 4th, and 2nd; the latter getting faint, as it was about being eclipsed. The third satellite was on the disc. Strange, however, to say, although only two shadows ought at this time to have been visible—namely, those of the third and fourth satellites, there were, to all appearance, most distinctly four shadows, three in a line, ranged along the centre belt, a little inclined to the north, and one at a considerable distance to the south-west, near the edge of the disc.

"At 9h. 57m. the shadow of the first satellite came on, making five distinct spots in all on the disc together, and, with the exception of the centre one of the three, which was rather pale, were black as ink, and vivid in the highest degree from their contrast with the glowing orb against which they were projected. I am quite at a loss to explain the cause of two more spots than could have been projected from the three satellites, and can only wait for the observation of others to confirm the appearance.

"Nothing could, I think, be finer than the aspect of Jupiter at 10h. 30m. His disc, of a delicate French white, was finely marked by five parallel belts. The shadows, in steady moments, stood out with wonderful clearness; and closely following two of them, I easily discovered the pale satellites, the colour of which so closely resembling that of the planet, are generally very difficult to recognise, unless with telescopes of large aperture."

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—For the purpose of comparison with others which you may receive, I enclose a sketch of the appearance of Jupiter last evening at 10h. 25m. G.M.T.

During the early part of the evening the sky was overcast, hence I was unable to observe the ingress of the first satellite at 8h. 14m. From 9h. to 11h., however, I was more fortunate; and although the air was rather unsteady, the belts of the planet were beautifully defined, and the transit of the shadows seen to perfection.

You will notice that I have shown in my drawing *five* spots on the disc; the second, counting from the *preceding* side, was of a greyish colour, and decidedly lighter than the shadows. This I imagine was the third satellite: the uppermost of the two, near the *following* side, must have been the fourth; yet it was fully as dark as the shadows, although at no great distance from the limb.

I used a power of 200 on a 4-in. o.g. by Cooke.

I am, Sir, yours faithfully,

Bedford: August 22, 1867. J. G. E. ELGER.

[Mr. Dawes' letter is delayed for an engraving; it will appear in our next.—*Ed.*]

On an Earlier Observation of the Comet discovered on the 3rd of April of this year. By Dr. Winnecke. Translated from Ast. Nach., No. 1645, by W. T. Lynn, B.A., F.R.A.S., of the Royal Observatory, Greenwich.

In the year 1855, De Vico's comet ought, according to Brünnow's elements, to have returned to perihelion on the 6th of August, and its geocentric course was favourably directed for the rediscovery. To assist in the search, Mr. Hind published, in the *Nautical Almanac* for 1858, three ephemerides: one under the assumption of the perihelion time given by Brünnow's calculations, the two others that it was earlier and later by four days. The zone thus marked out in the heavens was afterwards carefully and repeatedly swept by Bruhns and myself at the Berlin Observatory, but the comet was not detected.

It excited, therefore, no small astonishment when Goldschmidt published, in No. 978 of the *Astronomische Nachrichten*, issued on the 25th of August, 1855, a letter, dated Paris, July 7, in which was contained an observation of the comet on the 16th of May. I give the following extract:—"On the 16th of May, about 14 hours, in searching for De Vico's comet, I found a nebulous object, the place of which I immediately mapped down, amongst the surrounding stars. Yesterday evening I succeeded in comparing this drawing of their configuration with the heavens, and found the accurate place where I had seen De Vico's comet.* . . . . Having been only since the last fourteen days in the possession of a small equatorial, I was prevented on the 16th of May from determining the position. The approximate position is—

16 May, 1855, M.T., Paris 14h. 0m.
Star of comparison, Lalande, 42327.

	H.	M.	S.
Star reduced to epoch, R.A.	21	36	5·74
R.A. ♉ = R.A. ✱ + ...	0	5	40
∴ R.A. Comet . . . . . =	21	41	45·74

Reduced polar distance of the star = 105° 24′ 16″

Declination of the comet about 14′ more southerly than the declination of the star.

". . . . The principal thing is that I have positively observed a comet; in the telescope it was indeed faint, but very well visible with a power of 35; object glass 30 lines."

If we carry back the ephemerides given in the *Nautical Almanac* (which begin on the 24th of May), we obtain for Greenwich, midnight, on May 16, on the supposition that Brünnow's perihelion time was correct—

R.A. ♉ = 21h. 21m. 8; decl. ♉ = 17° 55′.

On the supposition that the true perihelion time was four days later—

R.A. ♉ = 21h. 36m. 2; decl. ♉ = —16° 52′,

so that the right ascension determined by Goldschmidt would indicate a perihelion passage later by 5½ days: the declination of the comet deduced from the elements would be 16° 5′.

Now the considerable difference between this and the declination estimated by Goldschmidt of itself makes it improbable that the nebulous object seen by him was really De Vico's comet. But how could it be possible, granting that Goldschmidt observed the sought-for comet, that a comet which was seen in the middle of May, or three months before its perihelion passage, with an aperture of only 30 lines, not far from its calculated place, should never have been seen with much more powerful instruments? for the expected visitor was also diligently looked for at other observatories. Breen, for instance, at Cambridge, sought in vain for the comet with the Northumberland equatorial (see *Ast. Nach.* vol. xliii. p. 246) "on every favourable occasion" during the months of June, July, September, and October.†

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* Goldschmidt adds here, that the place was too close to suffer him to suppose that he had rather seen some other comet.—W. T. L.

† Being myself also at that time attached to the Cambridge Observatory, I can bear testimony to the diligence and care with which Mr. Breen (whose lamented death last year is recorded in Vol. xxvii., No. 4, of the Monthly Notices of the Royal Astronomical Society) carried on this search. I had a share in it myself, although, from the state of my health at the time, it was but a small one.—W. T. L.

The object therefore observed by Goldschmidt cannot have been De Vico's comet, an opinion which is also shared in by the meritorious astronomer who occupied himself with the comet's apparition in 1844: compare Brünnow in Galle's "Supplement to Olbers's Treatise," page 50. Dr. Carl, indeed, in his "Repertory of Cometary Astronomy," refers to the observation as being one of De Vico's comet, but certainly incorrectly so. That Goldschmidt saw some comet or other I do not doubt: so practised and skilful an astronomer cannot have been deceived as to what he saw when he expresses himself so decidedly as he does in the above letter.

Now, the following consideration will make it probable that the comet which Goldschmidt did observe was that discovered on the 3rd of April of this year. His place, referred to the ecliptic, is—

$$\text{May 16, at 14h. 44m. Berlin mean time,}$$
$$\text{Longitude} = 322^\circ\ 30'\ 2''; \text{ latitude} = -\ 1^\circ\ 42'\ 6''.$$

Gauss has given, in § 74 of the "Theoria Motûs" (also earlier in Zach's *Monatliche Correspondenz*), a convenient solution of the problem, "from an observed direction of the line drawn from the earth to a heavenly body, and the known position of the plane of the orbit, to deduce the heliocentric place in the orbit." By a simple calculation there is obtained the argument of the latitude and the radius vector. In a given case the agreement of the radius vector thus found, with that determined from the argument of the latitude, after taking into account the other elements, decides whether the given elements correspond to the observed place of the body. When I obtained knowledge yesterday of the new ellipse of Herr Becker for Comet II. 1867, by which the earlier calculations of Bruhns are so beautifully confirmed, I immediately set about working out in this manner the hypothesis that the above-mentioned observation of Goldschmidt was in fact one of this comet. The agreement of the two values of log. r, obtained in the manner indicated above, left indeed something outstanding more than was desirable; however, the determination of the radius vector is in this case uncertain; also, I had not at hand for my calculation the ephemeris for 1855, and used only a rather rough place of the sun. Having to-day procured the *Jahrbuch* for 1855, I have taken up the calculation again, but followed a somewhat different course. The results of yesterday had shown that Goldschmidt's observation must have been made about 110 days after the comet's perihelion passage, according to which the intervals between the perihelion passages would amount to 4,497 days. On the supposition that two revolutions were completed in that time, the mean daily motion is consequently $576''\cdot39$; moreover, I retained the perihelion distance of Becker's ellipse, as probably the best determined, and changed the excentricity. I proceeded then from the following elements:—

$$\begin{array}{rcrl} & & {}^\circ & \ {}' \\ i & = & 6 & 17\cdot5 \\ \Omega & = & 101 & 54\cdot0 \ -\ 1855{,}0 \\ \pi - \Omega & = & 131 & 56\cdot4 \\ \phi & = & 32 & 22\cdot8 \\ \mu & = & \multicolumn{2}{l}{576''\cdot39} \end{array}$$

By referring the perihelion passage T to 1855, Feb. 6, 76 Berlin time, we obtain from these elements for the time of Goldschmidt's observation—

$$\text{Long.} = 322^\circ\ 30'\cdot2,\ \text{Lat.} = -\ 0^\circ\ 59'\cdot2,$$
$$\text{Log. } \Delta = 0{,}1705.$$

To an alteration of + 1 day in T would correspond an alteration of + 20'·5 in longitude, and of − 3'·1 in latitude. The difference from Goldschmidt's observation in latitude can scarcely appear strange if we reflect that the geocentric path of the comet has been hitherto by no means favourable to an exact determination of the orbit, and, moreover, that Becker's ellipse was deduced from observations before the perihelion of only a month and a half, whereas Goldschmidt's observation was about 3½ months after the perihelion. If one dared to assume a mistake in his letter, and read instead of "declination of the comet more southern," "more northern," the observation would fall almost accurately into the above ellipse.

On the hypothesis that the comet observed by Goldschmidt in 1855 was really identical with this of Tempel's, a very close approach to Jupiter took place in March 1858. The comet was, according to the above elements, in the early days of March in aphelion—T + 180° = 54°, aphelion distance, = 5,16; the heliocentric longitude of Jupiter at the same time is 52°, the radius vector 5,01. But, on account of the considerable latitude of the comet, the smallest distance from Jupiter amounted to more than 0,5. Of course, however, great perturbations took place, and this cause suffices to explain the deviation of the latitude of the comet calculated above from that observed.

On the supposition of a period of 2,242 days, the comet would have been well observable in the spring of 1861, but not at the earlier perihelion passages of 1848, 1842, and 1836. Two comets discovered by Olbers and Scheithauer, as well as by Pous, in the years 1817 and 1818, but imperfectly observed, cannot be identical with the present one, as is at once manifest on an inspection of the geocentric places.

ASTRONOMICAL PRONUNCIATION.

An unusual number of "printer's errors" were unfortunately left uncorrected on page 183 of our last number. Our correspondent who favoured us with a list of names has pointed out the following:—

For	Alcmēna	read	Alcmēne	For	Corna Berenīces	„	Coma Berenīcis
„	Algerab	„	Algorab				
„	Magistus	„	Megistus	„	Etānin	„	Etāmin
„	Autolўcus	„	Autolўcus	„	el-tannin	„	et-tannin
„	Betelgenæ	„	Betelgeux	„	Gibbeus	„	Gibbous
„	Betelgeúze	„	Betelgeuze	„	Japŏtus	„	Japĕtus
„	Canes benātĭci	„	Canes Venatici	„	Mamolўcus	„	Maurolўcus
„	Cleostiătus	„	Cleostratus	„	Raselgóti	„	Raselgéti
„	Clўtic	„	Clytie	„	Tāўgŏta	„	Tāўgĕta
„	Collimāter	„	Collimator				

Many persons having objected to the method of pronunciation adopted in the list in question, we forwarded their letters to our correspondent, who replies:—"I am obliged for the kindness of the friends you mention in sending me a list of mistakes, but, curiously enough, they are mistaken in every one of them. Very likely many persons pronounce the names as they do (for example, Alcўone), and usage in various instances has so fixed the mispronunciation that it would be difficult or impossible to alter it. Nevertheless, in putting forth a list, one should adhere to the classical quantities. The peculiar and erroneous vowel pronunciation that prevails in England gives rise to faults; for example, Urānĭa ought properly to be pronounced, not 'Urānia' nor 'Urannia,' but the *a* should have the foreign or continental (or Scotch) sound; giving it the which, the word is readily and properly pronounced. G. J. W."

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Many of your readers feel much obliged to you for the page in your August number on the Pronunciation of Astronomical Terms. The great difficulty in such a matter is to make a beginning, let it be ever so imperfect. It is easy to improve on the first attempt. Your correspondents may now offer suggestions and corrections, and may add some new names to the list; thus the subject will be satisfactorily treated in your pages. I desire to send a contribution, hoping that it will help to this result. I leave to others to correct the typographical errors (which are more than usual in a single page) and to suggest other improvements. I confine my observations to one particular—viz. the best mode of expressing the pronunciation of Greek and Latin words; and, first, I doubt very much whether it is desirable to mark the *quantities* which do not affect the pronunciation. Let me explain. We should mark the *quantity* of the penult syllable of all Greek and Latin words when of more than two syllables, as Erăto, Eridănus, Archȳtas, Præsēpe. The quantity of that syllable is indispensable, as the pronunciation of the word chiefly depends on it. But here the effect of quantity generally ceases. The quantity marked over any other syllable often leads to inaccurate, or, I should perhaps say, unusual pronunciation. Allow me to call attention to a few words having the unnecessary, though correct, *quantity* marked as given by you; see the first *quantity* in Alcy̆ŏne, Antĭŏpe, Callĭŏpe, Hy̆ădes. These are not helps, but hindrances, as the words are pronounced Al-cy′-ō-ne, An-ti′-ŏ-pe, Cal-li′-ŏ-pe, Hy′-ă-des, and the short mark seems to forbid the usual sound. Again, in words like Sīrius and Phōsphŏrus, the long quantities do not assist us, as these words are pronounced Sir′-ĭus and Phos′-phŏ-rus. The rule is, amongst classical scholars, regarding polysyllables, "when the penult is short the antepenult is accented, and the quantity of the antepenult is not regarded," as in the above examples. In dissyllables the quantity of their first syllables does not guide us in their pronunciation, as, for example, the constellations Lupus, Lepus, Canis Minor, &c., and the planets Venus, Ceres, Themis, Fides, &c.; all these having their first vowel short are yet pronounced Lu′-pus (not Lup-us), Le′-pus (not Lep-us), Ca′-nis Mi′nor (not Căn-is Mĭn-or), Ve′-nus (not Vĕn-us), Ce′-res (not Cĕr-es), The′-mis (not Thĕm-is), and Fi′-des (not Fĭd-es). Strange that the only dissyllable which you have given with the long penult (Ēcho) is pronounced generally with the penult short (Ek-ko), the Latin following the English word instead of leading it. With respect to our very few monosyllables in the nomenclature of the heavens, they too disregard the quantity of their vowels. *Cŏr* with its short *o*, and *mōns* with its *o* long, sound those vowels alike.

I think I have now shown that the *quantity* of the vowels is not a guide to be relied on in pronunciation except in the one position, the penult of polysyllables, as in Orīon, Thalīa, &c.

Secondly, allow me to suggest what I consider to be the best mode of expressing in print the pronunciation of the Greek and Latin words which form so large a share of astronomical terms. I have anticipated my answer to this question in the above attempts to give the pronunciation of the words I selected as examples—viz. to divide the word into syllables, to mark the accented syllable (or syllables), and to give the quantity when it is observed in the pronunciation—as Hes′-pĕ-rus, Hes-pe′-rĭ-a, Ū′-ră-nus, U-ra′-nĭ-a, A′-rĭ-es, A-ri′-ĕ-tis, Le′-pus, Lep′-ŏ-ris, Ca-no′-pus, Del-phi′-nus, Au-tol′-y̆-cus, Par-then′-ŏ-pe, Ni′-ō-be, Le′-o, Le-o′-nis, Crux′, Cru′-cis, &c. [I should here remark that those accustomed to Greek and Latin words only require the quantity of the penult of polysyllables.]

In the above I had in view (in hearing rather) the pronunciation which prevails amongst those educated at our universities, free from the influence of half-knowledge, affectation, or pedantry, who, as they say Rom'-ŭ-lus and Re'-mus, say also Reg'-ŭ-lus and The'-mis, showing that they disregard quantity in the penult of dissyllables and in the antepenult of polysyllables. They, however, never fail to mark in their pronunciation the quantity of the vowel in the penult of words exceeding two syllables, as in Urănus, Irēne, Erăto, Diōne, &c. In some English words which have altered the quantity, or rather have thrown back the accent, they follow usage, as in the words Or'ator, Am'azon, Cyclopæ'dia, Sama'ria, &c. They apply Horace's rule especially to pronunciation—"*Usus—et jus et norma loquendi.*"

Some of your correspondents may state to you, and prove by the rules of longs and shorts, that we are all wrong in our usual pronunciation of many of the above words. We reply that, even if it were desirable to reform the pronunciation that prevails amongst men of education and judgment, it is not for us astronomers to do that work: we are better engaged; our sublime and ennobling study, our sacred and holy and purifying meditations, raise us rather above that little matter, and we are quite content to call our most brilliant star *Sir'-ius*, and our brightest planet *Ve'-nus.*

We ought, though, to speak the same language amongst ourselves, and to know the prevailing pronunciation of the words we use. To assist us in this we look to your page 183 in its second and improved edition. Hoping, Sir, that you will long continue to increase our knowledge and enjoyment of astronomy, believe me, your much obliged, &c.,

Approach Road, Victoria Park: SENEX.
Aug. 12, 1867.

P.S.—We would all prize much even a short list (one or two dozen) of the Arabic names of stars, with their *usual* pronunciation; and if, in addition, you would give us the import of the words, we would feel doubly indebted to you. We enjoy the few names of which we know the meaning, as Arcturus (from its position, *the Bear's tail, or guard*); Procyon (from its rising in northern latitudes *before the Dog*), &c. We also guess, with satisfaction, at some Arabic words, from our knowledge of Hebrew, as *Ras* (the head), Rigel (the foot), Kochal (the star), and a few others. Pray, Mr. Editor, excuse my pen if it runs on (flies off rather) far beyond the bounds of our subject. May I express my admiration of that beauteous star before me? I am gazing at our evening western sky, this fitful August: there shines Arcturus in unchanging lustre—yet I imagine it does change; I really think it brighter than it was 56 years ago, when I saw it not far from the comet of 1811. I have been not merely enjoying it, but rejoicing in it ever since. Often and often have I cried to it,

Twinkle, twinkle, brilliant star;
How I wonder what you are!

Well, well, in the good time coming we shall have more light; I do believe that "the great multitude whom no man can number" will all be astronomers, and that the least *then* will be far beyond the greatest *now.*

[We have received other communications on this subject, which will appear in our next.]

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

THE PUBLICATIONS OF THE ROYAL ASTRONOMICAL SOCIETY.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Without quite approving of the tone of the letters which "A Fellow of the Royal Astronomical Society" has published in your columns, and without entering into the question whether the Society can or cannot afford to distribute their "Memoirs" to each "Fellow" gratis, I cannot help joining with him in his complaints of the unnecessarily late publication and issuing of the *Monthly Notices.* Instead of improving, matters have lately got worse than ever; and I, for one, did not get my notice of the meeting held on the 14th June last until the 25th or 26th of July, six weeks after the meeting! Now this really is too bad. No one can doubt but that with ordinary diligence the notice of any meeting might be issued by the 1st of the ensuing month, and steps ought to be taken to secure the attainment of that result.

Clearly the employment of an Editor of recognised ability (as our present Editor undoubtedly is) is a most desirable thing; but, then, if the present salary is not of sufficient amount to secure an able man's prompt and regular attention to his editorial duties, surely the stipend should be increased, and surely the Society can afford to pay the increase. But if, on the other hand, the delay arises from the learned Editor's time being too much taken up with other pursuits, then the only remedy seems to be to find another Editor. Anyhow, the country Fellows (who, but for the information supplied by the *Astronomical Register*, would be without astronomical news) have a fair right to insist upon an earlier publication of the *Monthly Notices.*

I am, Sir, your obedient servant,
A FELLOW OF TEN YEARS' STANDING.

August 10, 1867.

COMPANIONS OF VEGA.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

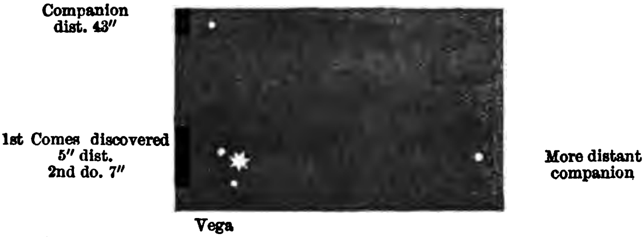
Sir,—At the present season, whilst Alpha Lyræ is so favourably situate for examination, it may be of sufficient interest to announce the discovery of two companion stars much closer than the well-known "*comes*" of Vega. On the evening of the 18th July I had the privilege of seeing several very close double stars with the 9-inch equatorial in the observatory of James Buckingham, Esq., of Walworth Common, when that gentleman asked me to examine Alpha Lyræ, saying that some time previously he had discovered one or two companion stars much closer than any before known. On turning the telescope to that star I at once saw one of them, and described the position and the distance by comparison with the known distance of the companion star, fixing it at five or six seconds. These data coincided with Mr. Buckingham's. But, owing to the fitful and unsteady atmosphere, it was some time before I was able to catch up the *second* companion, which seemed fainter and somewhat more distant.

I believe that Mr. Buckingham first discovered these two companions with his 20-inch refractor, and was able afterwards to verify his discovery with the 9-inch equatorial in which I saw them; but though he recorded the fact at the time, he did not publish his discovery. As I also was able to see the companions clearly, and tested the sight by turning consecutively half-round the eye-piece and object-glass with the same result, and as I have no doubt possessors of similar telescopes will be able to make them out easily, it seemed to me that a discovery of such a system attending Vega should be made known, as of course it would be invested with an interest second to none in the list of double stars.

From memory I just annex a rough diagram of the position of the stars around the central Vega, which may serve as a sort of guide to amateurs like myself in the investigation of this interesting subject.

I am, yours very faithfully,

July 20, 1867. R. C.



γ^2 *ANDROMEDÆ.*

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Permit me through your pages to inform Mr. Darby that the *new* 20-in. clear aperture object-glass, which I have just *finished* for Mr. Buckingham, shows γ^2 Andromedæ separated with all powers above 200, and that with a power of 450 the distance between the components is much wider than in proportion to Mr. Dawes' diagram, evidently showing that the separating power depends mainly on the size of aperture; at the same time, to separate well, we must have a good correction of the chromatic and spherical aberrations. With the 9-in. aperture, which I also executed for Mr. Buckingham in 1859, the components of γ^2 are seen to agree more with Mr. Dawes' than with Mr. Darby's diagram.

To the 20-inch object-glass, just finished, ζ Herculis, and δ Cygni, are astonishingly easy objects. We have not as yet had time to make much scrutiny, but the most difficult tests have hitherto, with the full aperture, been instantly resolved, even in but an indifferent state of the atmosphere.

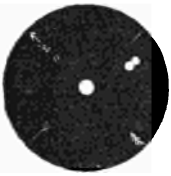
I am, Sir, yours truly,

1 Clifton Villas, Highgate Hill: WM. WRAY.
Aug. 13, 1867.

μ^1 AND μ^2 BOÖTIS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I send you an eye-sketch of μ^1 and μ^2 Boötis as I saw it on the 27th of July. In my letter on γ^2 Andromedæ, in your August No. of the *Register*, I omitted to state that the arrow on the diagram indicated the passage of the star across the field of the telescope, which is oblique because not taken on the meridian, but about three hours after the meridian passage.



μ^1 & μ^2 Boötis.

μ Boötis resembles in some respect γ Andromedæ: both are triple stars, both have companions closely double, and both require first-class telescopes, high powers, and a good eye to resolve them. μ^2 Boötis is, in my estimation, a closer star than γ^2 Andromedæ, arising, as I think, from the following circumstances:—

"The great star γ^1 Andromedæ is 3½ magnitude, of a glaring orange colour, and placed within 11″ of γ^2 and its close companion, rated at 5 and 6·3 magnitude (Rev. R. Main estimates them at 7½ and 8½); μ Boötis is 4 magnitude flushed white, and 109″ distant from the close pair, all the more favourable for μ^1 can be placed quite out of the field with a high power. Moreover, γ^3 is rendered very difficult to catch, except with a very large aperture telescope, from the fact of its lying nearly behind γ^2 in the *s.f.* quadrant. So that it is more a matter of aperture than of mere definition to bring out the small star to the eye of the observer. There is no doubt, to my mind, but that Mr. Dawes was right in maintaining that the smallest aperture telescope that will separate the small stars satisfactorily is about 7¾ inches; a less aperture may notch or elongate them, but that they have been thereby actually divided has not, I think, yet been established. On the other hand, μ^3 Boötis lies well up to the eye, and nearly on the line from μ^1 through μ^2, which is a favourable circumstance for the observer.

"In discussing the position and distance of A B, as found by Sir W. Herschel and S. in 1821, and which are almost identical with my own, Sir J. Herschel considers their fixity of importance in establishing by indisputable evidence the fact of the close pair's rotation. In 1781, it was remarked by Sir W. Herschel, that the small star [μ^3] followed the line joining the large one to μ [μ^1 and μ^2], and in 1802, that it had changed sides and preceded the same line. The following object [μ^2 Boötis] will show that this change is fully confirmed, and a distant period may ascertain whether the whole system has a common proper motion in space."—*Smyth's Cycle*, p. 342.

Assuming that Admiral Smyth's references and quotations in this paragraph are correctly given, which I have no opportunity now to ascertain, there appears to be some strange mistake. In the excellent and very useful catalogue of Binary Stars, by Mr. Alfred Brothers, given in the April No. of the *Register*, the angles of position of μ^2 Boötis, collected from the observations of the most eminent observers, show that the small star μ^3 *did not really change sides*, or make the revolution of two whole quadrants, from 1781 to 1802. At such a rate of progress, the period, instead of being 622 years (Sir J. Herschel), or 589 years (J. R. Hind), or 460 years (Admiral Smyth), must of necessity be a short period—within 100 years. The angle of position given by Sir W. Herschel in 1781·68 is 357°·14, and that by Struve in 1829·73 is 324°·05, showing a retrogression of only 33°·09 in 47 years, instead of 180° in 21 years, as stated by Sir W. Herschel. Moreover, it is evident from the table of positions given in Mr. Brothers' catalogue, that the small star *did not follow the larger star*, that is, μ^3 did not *follow* but *precede* μ^2 on the line joining μ^2 to μ^1 (the relative fixity of μ^1 and μ^2 being established by all measures since 1781). It follows, therefore, that Sir W. Herschel, by a mistake, wrote *followed* for *preceded* in the observation of 1781, and that, even with this correction, the description was not rigidly correct: and, again, that "the observation of 1802, which states that the small star μ^3 had changed sides in relation to μ^2 on the line to μ^1 since 1781, must be in error, for after the lapse of 86 years the small star has not hitherto accomplished that semi-revolution. Nor was it, in fact, quite correct to say that in 1781 the small star *preceded* (for the angle of position shows this was what was meant) the larger star on the line to the great star, as is sufficiently evident from the position of μ^1 and μ^2, as given by Piazzi in 1800,—pos. 171°·5, dist. 112″0, 1800, &c."

Critics tell us that Homer, the prince of poets, sometimes nods, and they thus account for the dullness of some of his verses. It would be no wonder at all, considering the severity and extent of his night labours, if Herschel, the prince of astronomical observers, were found occasionally nodding; but taking into account his voluminous observations, extended over so long a period, his accuracy is perfectly marvellous.

Very truly yours,

Chorlton Hall, Manchester: WM. ARTHUR DARBY.
August 16, 1867.

JUPITER'S SATELLITES.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The nights of July 28th and 29th were remarkably clear and still in Guernsey, and the planet Jupiter being very brilliant and steady, although not far from the horizon at 10 P.M., I was induced to try whether I could discern any of the satellites with the naked eye. On excluding the surrounding light with my hand, I perceived very distinctly a minute star close to the planet, on the left, and on applying a pocket-glass of 1-inch aperture, observed that two of the satellites were close together in the place noted, the outer being the brighter. On the following evening the same point was again visible, but with more difficulty, and the glass showed the two satellites still near each other, but the inner the brighter.

On referring to the *Nautical Almanac*, after my return home, I see that on the 28th the 2nd, 3rd, and 4th satellites were near my observed position, and the 3rd and 4th on the 29th, but further apart, and the 3rd outermost. I am inclined, therefore, to think, as I stated in a former communication on the same subject (*Astronomical Register*, No. 6), that while much no doubt depends on the quality of the eye, the recorded instances of visibility will perhaps be found to coincide with the juxtaposition of the satellites, whose combined light then stimulates the eye in a greater degree; and it would not be uninteresting were observations made to ascertain this at the times indicated in the *Nautical Almanac*.

As regards the susceptibility of the eye, I may add that on this occasion I discerned the satellites far more readily with the left eye, to which objects appear brighter and larger, than with the right, with which, while their colour and size are reduced, the definition, especially with the telescope, is infinitely superior.

Ealing: I am, Sir, your obedient servant,
Aug, 14, 1867. WM. L. BANKS.

ASTRONOMICAL OCCURRENCES FOR SEPT. 1867.

DATE			Principal Occurrences	Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon
Sun	1	 9 0	Sidereal Time at Mean Noon, 10 40 43·4 Moon's libration—greatest portion of the NW. quadrant visible			— 2 29·7
Mon	2		Meridian passage of the Sun, 20s. before Mean Noon			3 17·6
Tues	3	10 57	Conjunction of Moon and Saturn, 2° 48′ S.	1st Oc. D.	16 18	4 4·9
Wed	4			1st Tr. I. „ Sh. I. 2nd Oc. D. 3rd Tr. I. „ Sh. I. 1st Tr. E. „ Sh. E.	13 30 13 46 13 47 14 45 15 46 15 50 16 5	4 51·9
Thur	5	11 31	☽ Moon's First Quarter	1st Oc. D. „ Ec. R.	10 44 13 18 10	5 39·0
Fri	6			1st Tr. I. „ Sh. I. 2nd Tr. I. „ Sh. I. 1st Tr. E. „ Sh. E. 2nd Tr. E. „ Sh. E.	7 56 8 14 8 26 9 2 10 16 10 34 11 18 11 54	6 26·3
Sat	7	9 49 10 22	Occultation of B.A.C. 6292 (6) Reappearance of ditto	4th Sh. E. 1st Ec. R.	7 10 7 47 1	7 13·7
Sun	8	9 47 10 51	Occultation of ρ^2 Sagittarii (5½) Reappearance of ditto	3rd Ec. R.	9 11 2	8 1·2
Mon	9					8 48·5
Tues	10	9 2	Conjunction of Venus and Mercury, 0° 24′ N.			9 35·5
Wed	11	23 53	Conjunction of Moon and Jupiter, 2° 42′ S.	1st Tr. I. „ Sh. I.	15 14 15 40	10 22·3
Thur	12	17 31	Near approach of Moon to λ Aquarii (4)	1st Oc. D. „ Ec. R.	12 29 15 13 24	11 8·8
Fri	13	 12 33	Eclipse of the Moon, visible at Greenwich ○ Full Moon	1st Tr. I. „ Sh. I. 2nd Tr. I. „ Sh. I. 1st Tr. E. „ Sh. E. 2nd Tr. E. „ Sh. E.	9 40 10 9 10 43 11 39 12 0 12 28 13 35 14 32	11 55·5
Sat	14	14 0 14 31 21 48	Moon's libration—greatest portion of the NE. quadrant visible Near approach of Moon to 10 Ceti (6) Superior Conjunction of Mercury	1st Oc. D. „ Ec. R.	6 55 9 42 18	12 42·7

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Sun	15			**1st** Tr. E. „ Sh. E. **3rd** Oc. D. **2nd** Ec. R. **4th** Oc. R. „ Ec. D. **3rd** Ec. R. **4th** Ec. R.	6 26 6 57 7 33 8 58 51 9 38 10 3 54 13 11 52 14 27 4	Moon — 13 30·8
Mon	16	 16 14 17 3	Sidereal Time at Mean Noon, 11 39 51·7 Occultation of ξ^1 Ceti (4½) Reappearance of ditto			Jupiter — 10 28 2
Tues	17		Meridian passage of the Sun 5m. 27s. before Mean Noon			10 23·9
Wed	18					10 19·5
Thur	19			**1st** Oc. D.	14 14	10 15·2
Fri	20	15 9	☾ Moon's Last Quarter	**1st** Tr. I. „ Sh. I. **2nd** Tr. I. **1st** Tr. E. **2nd** Sh. I. **1st** Sh. E.	11 25 12 4 13 2 13 45 14 18 14 23	10 10·9
Sat	21	17 12	Conjunction of Moon and Uranus, 4° 59′ N.	**1st** Oc. D. „ Ec. R.	8 41 11 37 41	10 6·6
Sun	22	14 7	Near approach of Moon to ι Cancri (6)	**1st** Sh. I. **2nd** Oc. D. **1st** Tr. E. „ Sh. E. **3rd** Oc. D. **2nd** Ec. R.	6 32 7 24 8 11 8 52 10 54 11 34 12	10 2·3
Mon	23			**1st** Ec. R. **4th** Tr. I.	6 6 28 14 13	9 58·0
Tues	24			**2nd** Sh. E.	6 30	9 53·7
Wed	25	3 17	Superior conjunction of Venus			9 49·4
Thur	26					9 45·2
Fri	27	11 42 12 28	● New Moon Conjunction of Moon and Venus, 0° 34′ S.	**1st** Tr. I. „ Sh. I.	13 11 13 59	9 40·9
Sat	28	5 19	Conjunction of Moon and Mercury, 2° 31′ S.	**1st** Oc. D. „ Ec. R.	10 27 13 33 9	9 36·6
Sun	29	12 10 0 0	Conjunction of Moon and Mars, 4° 7′ S. Moon's libration—greatest portion of the NW. quadrant visible	**1st** Tr. I. „ Sh. I. **2nd** Oc. D. **1st** Tr. E. „ Sh. E. **2nd** Ec. R. **3rd** Oc. D.	7 38 8 27 9 42 9 57 10 47 14 9 43 14 19	9 32·4
Mon	30			**1st** Ec. R.	8 1 58	9 28·2
OCT. Tues	1	0 10	Conjunction of Moon and Saturn, 2° 56′ S.	**2nd** Sh. I. „ Tr. E. „ Sh. E.	6 16 7 26 9 8	9 24·0

THE PLANETS FOR SEPTEMBER.

Mercury rises on the 1st of September at four minutes before four o'clock in the morning: he rises with the sun about the middle of the month, and sets about an hour and a quarter after him at the end.

		h.	m.	s.			°	′		
1st	R.A.	9	53	53	Decl.	+	14	19½	Diameter	5″·4
15th	„	11	33	55	„		4	31½	„	4″·8

Venus arrives at superior conjunction with the sun this month, and consequently is unfavourably placed for observation, except early in the morning at the beginning of September.

1st	R.A.	10	18	4	Decl.	+	11	59	Diameter	9″·8
15th	„	11	23	23	„		5	29½	„	9″·6

Illuminated portion of the disc of Venus, 0·999.

Mars may yet be seen for a short time after sunset.

1st	R.A.	12	50	54	Decl.	−	5	8½	Diameter	4″·8
15th	„	13	25	3	„		8	47½	„	4″·6

Illuminated portion of the disc of Mars, 0·972.

Jupiter continues to be the most conspicuous object in the heavens during the night.

1st	R.A.	22	16	59	Decl.	−	12	6	Diameter	49″·8
15th	„	22	10	25	„		12	42½	„	49″·2

Saturn, like Mars, sets shortly after the Sun.

1st	R.A.	15	7	40	Decl.	−	15	26½	Diameter	15″·8
15th	„	15	11	40	„		15	46	„	15″·6

Dimensions of ring—Outer Major Axis, 36″·0; Outer Minor Axis, 14″·0.

Neptune may be observed with advantage during September and October. The planet passes the meridian about midnight at the end of the present month.

6th	R.A.	0	53	51	Decl.	+	4	12
18th	„	0	54	47	„		4	5

ASTRONOMICAL BIOGRAPHY.—Is there any Biographical work in English, French, or German, devoted exclusively to Astronomers? If not, would not such a work be desirable? Would some one indicate the sources from which it might be compiled? H. J.

REFLECTORS.—Mr. Browning, in his "Plea for Reflectors," says that Mr. Cooper Key, about three years ago, discovered a more simple method of parabolising specula: has this method ever been made public? and if so, where? J. L.

THE SUN AND MOON.—We are told that the Moon never turns round to the Earth, and only once a month to the Sun; I should like to know how often the Sun turns round to the Moon. May I ask from your learned correspondents a simple explanation thereof? that is, not too technical or abstruse for an IGNORAMUS.

NEPTUNE.—It may be serviceable to those of your readers who have not equatorial mountings, to hear that on the 11th of July Neptune was in the field along with 77 Piscium, with low powers, and still continues so in my 2-inch finder, with power of about 25, preceding, and slightly to the North. H. E. LOWE.

INSTRUMENTS, &c. FOR SALE.

These Notices, which are restricted to *two lines* each, are inserted free of charge to subscribers: applications respecting prices and other particulars to be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—For Advertisements with prices and more complete details, a small charge will be made.

N.B.—It is particularly requested that we may be informed when instruments are disposed of, in order that the notice may be withdrawn, and fruitless applications prevented.

Achromatic Refractor, 6·4 in. ap. 8½ ft. focus, by *Merz*, Equatorial and clockwork by *Troughton & Simms.* [73]

Achromatic Refractor, 4½ in. ap. by *Alvan Clark*: equatorially mounted; no circles. Powers to 450. [110]

Achromatic Refractor, 4 in. aperture, by *Cooke & Sons*; equatorially mounted, complete in every respect. [104]

Achromatic Refractor, 4 in. ap. 5 ft. focus, by *Dollond*; equatorially mounted. Powers up to 400. [87]

Achromatic Refractor, 3¼ in. ap. 50 in. focus, with brass tripod, comet, landscape, and 4 other powers 74 to 260. [111]

Gregorian Reflector, 4¾ in. ap. 2 ft. focus, by *Dollond*, 4 powers, 50 to 200, finder, &c., on brass table stand. [63]

Achromatic Object-Glass, 4⅛ in. ap. 62 in. focus, by *Slugg*, with brass cap and receiving cell, for mounting on tube. [85]

Silvered Glass Speculum, 10⅛ in. diameter, 7 ft. focal length, of excellent quality, by *Mr. With*, in wooden tube; price moderate. [101]

Transit Instrument, 3¾ in. ap. 5 ft. focus, Ys fitted with agates for mounting on stone piers. [29]

Transit Instrument, 2¾ in. ap. 30 in focus, by *Troughton & Simms*, with micrometer eye-piece and cast-iron adjustible stand. [107]

Equatorial Stand, for 5 ft. telescope: with circles, &c. complete. [99]

Equatorial Stand, for a 5 or 6 ft. telescope: 13 in. circles, divided on silver, to 10″ of space and 4s. of time.—Has never been used. [55]

Polar Axis, of mahogany, 7 ft. long, adapted for a 4 ft. telescope, with 12 in. circles, reading to minutes. [56]

Right Ascension and Declination Circles, 10 in. [109]

Speculum Grinding Apparatus, capable of working a 7 ft. speculum: with tube and fittings for a 9 in. Newtonian. [57]

Recreative Science: and the first three volumes of the **Photographic Journal**: price very low. [30]

Lalande's Astronomy, 2 vols. 4to. [108]

INSTRUMENTS, &c. WANTED.

Astronomical Clock, not very first-class; price low. [65]

Equatorial Stand, for a 5 ft. Refractor: graduated circles. [35]

Garden Stand for 8 ft. Achromatic; price low. [112]

Brass Tripod for a 2 ft. Telescope: condition not material. [106]

Transit Instrument, 2 in. ap. 18 or 24 in. focus. [71]

Transit Instrument, 1½ in. aperture, about 20 in. focus. [102]

Monthly Notices of the Royal Astronomical Society, Vol. 3. [26]

Monthly Notices: Vol. 5, No. 12. [82]

Bartholomew Prescot on the Universe, published 1823: a copy wanted, in good condition. [84]

Galbraith's Mathematical and Astronomical Tables, 2nd edition. A good price will be given for a clean copy. [105]

THE CONSTELLATION SEASONS. By the Rev. R. A. Proctor, B.A., F.R.A.S. 4to. London: Longmans.—A very useful series of twelve Lithographic Maps, in which the stars are given to the fourth magnitude. In this series, Mr. Proctor follows up his Pentagonal Maps by a set intended rather more for the use of the beginner; although they will be found of much value to the advanced astronomical student, who may frequently require in his reading to answer such questions as "Where was such and such a star at such a time?" There are sixteen pages of introductory matter with respect to star maps—very interesting as coming from one who has given so much attention to this subject as Mr. Proctor. We can recommend the "Constellation Seasons" as giving a large amount of information on the subject in a clear manner, and at a very moderate price.

ON THE EXCENTRICITY OF THE EARTH'S ORBIT, AND ON THE CHANGE IN THE OBLIQUITY OF THE ECLIPTIC, are the titles of two interesting papers by Mr. Croll, Member of the Geological Society of Glasgow.

ECLIPSE OF THE MOON.—A partial eclipse of the Moon will take place on the evening of Friday, the 13th of September, commencing about twenty minutes to ten o'clock.

	h.	m.	
First contact with the penumbra	9	43·3	Greenwich mean time.
First contact with the shadow .	10	57·4	
Middle of the eclipse . .	12	26·2	
Last contact with the shadow .	13	55·0	
Last contact with the penumbra .	15	9·1	

Magnitude of the eclipse (Moon's diameter = 1) 0·693.

The first contact takes place at 34° from the North point of the Moon's limb towards the East; the last, at 69° towards the West; for *direct* image.

LIST OF SUBSCRIBERS—Name received since our last number.

Perrens, J. Dyson, Esq., Davenham Bank, Malvern.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June 1867.
Vallance, P.
To September 1867.
Metcalf, Rev. W. R.
Welsford, J.
To December 1867.
Banks, W. L.
Crowe, Rev. R.
Parkes, Rev. J.
Perrens, J. D.
Sargent, Rev. J. P.
Simkiss, T. M.

Aug. 26.

NOTICES TO CORRESPONDENTS.

Several communications are deferred from want of space.

Correspondents communicating with the Editor are particularly requested to notice the change in the address to Parnham House, Pembury Road, Clapton, N.E., instead of Stamford Villa, as heretofore.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 58. OCTOBER. 1867.

THE PLANET JUPITER WITHOUT HIS SATELLITES.

Several of the numerous letters we have received on this subject are accompanied by drawings more or less carefully executed of the appearance of the planet on the evening of the 21st August. From these we have prepared a sketch of the phenomenon as seen in a moderate-sized telescope, a wood engraving of which we present to our readers with this number of the *Register*.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The ingress of the third satellite of Jupiter, and also of the shadows of the third and fourth satellites, could not be observed here last evening because of clouds and the low altitude of the planet.

The first observation obtained was that of the eclipse of the second satellite, and as from that time until the egress of the fourth satellite this morning, the sky was cloudless, the remaining observations were made satisfactorily.

The third and fourth satellites entered on the disc very bright and distinct, but as they got clear away from the limb they gradually faded, until they could not be seen; a little further on, they reappeared as dark spots, deepening in shade until they were black, and on comparing them with their shadows, they seemed smaller, but not quite so black. The fourth could not be distinguished in size or colour from the shadow of No. 1. The third was not quite so dark. They remained black until they arrived at about the same distance from the other limb, when they disappeared the second time, and again reappeared bright before they got quite to the limb.

The first satellite was seen on the limb, and just inside of it, very bright indeed, but it faded as it got on to the disc away from the limb, and after a time could not be distinguished from the planet: it continued so until it arrived near the other limb, when it reappeared bright.

There was a sort of border, or halo, round the shadows of the third and fourth satellites, but none could be certainly seen round that of No. 1. As the shadows passed off the planet, they gave a decided impression of the roundness of the planet near the limb; but this appearance was not noticed at the egress of the satellites themselves.

The following measures were taken at 10h. 30m. p.m.: Lens, 6-inch; power, 220:—

		″
Preceding limb to shadow of No.	3	12·53
" " "	3	17·81
" " "	4	25·54
" " "	4	36·84
" " "	1	36·84

Diameter of disc = 49″·5.

I remain, Sir, yours respectfully,
Waterloo, near Liverpool: JOHN JOYNSON.
August 22, 1867.

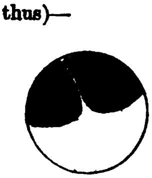
JUPITER WITHOUT A VISIBLE SATELLITE.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The usual designation of the interesting phenomenon which was seen here last night requires in strictness a slight modification to enable it accurately to describe what was visible with a powerful telescope. As thus seen, it might more correctly be termed "*Jupiter* without a visible Satellite *extraneous to his disc.*" When all had in this sense disappeared, they were still, with the exception of the second, visible, as projected on the planet's disc.

The *first* was seen as a small bright spot near the eastern edge, to the south-east of its own shadow, and at less distance from it than its own diameter; the *third*, as a nearly round spot, partly bright and partly very dark—in fact, almost black; and the *fourth*, as a nearly round spot, so dark as scarcely to be distinguished by its colour from its own shadow, which, however, was much larger than itself.

Observing with an exquisitely perfect 8-inch refractor by Cooke & Sons, I noticed nothing unusual in the first satellite or its shadow. This was far from being the case with the *third*, the appearance of which was very remarkable. Considering how near it was to the planet's centre, its NE. side was strikingly bright. On the contrary, the SW. half was extraordinarily dark—scarcely less so than its shadow. During transient fits of fine definition, the form of the dark part was clearly discernible; but, though the shape reminded one forcibly of the figure which I have seen and depicted on former occasions (see Mon. Not. R.A.S., April 1860, figs. 2 and 3), yet the dark portion of the satellite was almost precisely on the opposite side of its disk; (appearing thus)—



The bright part of the satellite seemed to project a little beyond the contour of the circle, as if by irradiation; so that taking the dark and bright portions together, the satellite appeared slightly elongated in the direction NE. to SW.

The *fourth* satellite was also a remarkable object, the whole of its disc being so extremely dark as scarcely to be distinguished from its shadow, except by the smaller size of the satellite. The closest scrutiny of the shadow failed to detect any decided diminution of its blackness towards its circumference; so that not only the extent of the penumbra, but even its existence, was not to be certainly perceived. The same may be said of the shadow of the third satellite.

When the image was sufficiently free from light cloud and tremour, the most efficient power on the 8-inch refractor was 412.

I remain, yours faithfully,
Hopefield Observatory, Haddenham, Bucks: W. R. DAWES.
1867: August 22.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Not having seen any account of the astronomical phenomenon on the 21st August last agreeing altogether with my observation of it through my 9-inch equatorial, perhaps the following account may be acceptable to your readers.

The weather here appeared likely to be indifferent, and, from the position of the planet, I did not expect a good view of the commencement of the transit; but the clouds gradually cleared off, and I saw the planet well before the ingress of the third satellite, which was clearly defined, and, at that time, its black shadow was on the disc. As the shadow of the third satellite passed on towards the opposite side of the planet, and when the shadow of the fourth satellite came on the disc, I saw distinctly the third satellite itself half way between the shadow of the third and fourth satellites, and with wonder and delight, I distinctly perceived such third satellite to be of a cinnamon colour, with two spots connected together, of a darker cinnamon or *sponge* shade, towards the apparent east side. Then the fourth satellite made its appearance on the disc, and, to my great surprise, it was as black as its shadow, and apparently of about the same size, or a little smaller.

Soon after that, the shadow of the first satellite came in view, followed in a few minutes by the first satellite itself, which was of a pale cinnamon, or straw colour; and the second satellite having become eclipsed, no satellite could then be seen beyond the range of the planet itself. The view of three satellites and three shadows, making six circular spots of the colours mentioned on the disc of the planet, was then intensely interesting, and the effect was much heightened by the appearance of the belts, which were most distinct, and chiefly of a beautiful pink rose colour, looking more like terrestrial clouds of that tint than I had ever before seen them. Before looking at the planet, I had seen Mr. Proctor's excellent drawing of the phenomenon, in the July, 1867, number of the *Popular Science Review*, and on referring to it again afterwards, the places of the satellites and their shadows appeared exactly as I had observed them at about the time indicated.

I did not note with care the exact times of the respective ingresses and egresses, or of the eclipse, but the times given in the *Nautical Almanac*, and by Mr. Proctor, for Greenwich, seemed correct.

I particularly invite attention to the colours of the satellites and of the belts as seen by me, and which I hope may agree with Mr. Dawes's description promised in your last number, and whose drawing, I trust, may be coloured. Yours faithfully,
South Villa, near Worcester: THOMAS BARNEBY.
September 9, 1867.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Respecting the appearance of Jupiter without his moons on the 21st ult., none of your correspondents seem to have been so favoured, atmospherically, as myself. They all omit to mention, or were unable to see, one of the most remarkable of the phenomena that night.

When Jupiter rose above the mist on the horizon, at about 8h. 20m. P.M., the sky was perfectly free from cloud, and the air beautifully calm and clear. The first, second, and fourth satellites were visible, and the shadow of the third distinctly seen on the face of the planet. But the most remarkable thing at that time was the extraordinary *dimness* of the fourth satellite; compared with the first, nearly below it, the latter appeared very much larger and brighter. This was so very noticeable, that I came to the conclusion astronomers had either made a mistake in the position of the satellites, or this was one of those rare instances when the fourth satellite has appeared so much fainter than its companions. At 10h. 15m. my observation was confirmed by seeing the fourth satellite itself on Jupiter's belt as a black spot, thereby proving that the duskiness of the satellite, which caused it to appear on Jupiter as a black spot, had also produced the faintness in its light before transit. I regret I was not able to discern the 3rd satellite before entering on Jupiter's face, as doubtless a similar dimness in its light would have been noticed to account for its subsequent appearance. My other observations correspond with those detailed in this month's *Register;* they were made with a 2¾-inch achromatic, power 250, which the state of the atmosphere allowed me to use with great success.

I am, Sir, yours truly,

Burton-on-Trent: Sept. 3, 1867. E. B. KNOBEL.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—On the night of the 21st of August the sky in this vicinity was obscured by dense clouds. At intervals only did the planet Jupiter become dimly visible, so that it was not possible to note the instant of transit of the third and fourth satellites on to the disc of the primary.

About 9h. 30m. the clouds became thinner, and the shadows of the two satellites just referred to were plainly seen in Mr. Barnes's 10¼-inch silvered-glass reflector, but the satellites themselves could not with certainty be made out. At this time Jupiter appeared absolutely without satellites in a 5-foot achromatic that was attached to the side of the large equatorial. The sky becoming clearer at 10h. 4m., the first satellite, which was third in the order of transit, was seen to touch the edge of the disc. After passing on to the disc to the extent of half its diameter, it seemed for a brief space to remain stationary, like a brilliant bead. Passing then on to the disc, its brilliancy rapidly diminished, although it remained visible until 11h. 30m., when the clouds closed up thick and heavy, and obscured all further view of this most interesting sight.

It is a most curious fact, requiring explanation, that the satellites should appear so brilliant as to be readily seen when they are on the edge of the planet, where the disc is brightest, and yet, as they approach the centre of the planet, traversing the dark belts, where by the force of contrast we should expect that they would be most plainly visible, that they should be almost lost to view, or, even as I have once witnessed on a very clear night, become absolutely imperceptible.

I am, Sir, your obedient servant,

Upper Holloway: Sept. 13. JOHN BROWNING.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The disappearance of the satellites of this planet on August 21st was well seen here, and the various phenomena so nearly resemble the descriptions of your correspondents in the September number, that a detailed account would be but a wearisome repetition. There is, however, one very interesting particular of which I do not see any notice, viz., the closeness of the disc of III. and the shadow of IV. when entering on Jupiter's disc. In fact, they appeared in actual contact, much like the discs of a close double star, when strongly elongated or notched.

On referring to the *Nautical Almanac*, I find there was an interval of three minutes of time between the entering of III. and the shadow of IV. on the disc, which shows that they must have been very close, and also that III. had but just before overtaken and passed the shadow of IV. with such a minute difference of declination, that it must have been partially, if not totally, eclipsed in the shadow of its more distant neighbour.

This idea is further strengthened by the appearances presented to the telescope, in which the shadow of IV., at its first entering on the disc, was strangely elongated, the elongation speedily assuming the appearance of discs in contact, and as the greater velocity of III. carried it clear of the shadow of IV., they were observed to separate, the lighter tint of III. clearly distinguishing it from the shadow of IV., which was also much smaller. The least contemplation of the motions of the satellites will show that mutual eclipses may take place, and they probably do occur with considerable frequency; and though we have no recorded instance of the disappearance of a satellite from this cause, we must attribute this to the fact that, from the rapid movements of the satellites, such eclipses must be of very brief duration, and without proper calculation an observer would not be likely to be on the watch at the proper time.

During some fine intervals the disc of III. was repeatedly suspected to be spotted, the preceding limb being the darkest, but the tremulous state of the air rendered this uncertain.

The instrument used was the 6½-inch silvered-glass reflector, described in the July *Register*, with the performance of which I have every reason to be highly gratified.

Yours very truly,

Sept. 1867. C. GROVER.

P.S.—The transits of I. and II. on the 30th were well seen here, and are worthy of note from the very different appearances of both satellites and shadows. The first satellite did not become visible till it approached the limb, when it appeared as a white spot on the bright equatorial channel, and the quickness with which it started into visibility, and increased to a clear, round, and well-defined disc, was something wonderful.

The second satellite, though traversing the dark south belt, was very obscure; even near the limb, the disc seemed very irregular, and was difficult of observation. The shadows were as different in appearance as the satellites: that of I. was sharp and well defined, and when half emerged from the planet, formed a curious indentation in its margin; while the shadow of II., though plainly seen, seemed very ill-defined and hazy, as if encompassed with a very dense penumbral shadow, and, when near the limb, barely visible.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I enjoyed a fair view of the phenomena of Jupiter's satellites on the 21st August. I hope you were equally fortunate. The third appeared as an irregular dusky spot for about an hour and a quarter. I made several rough sketches of the appearances at different times. I saw nothing on the 28th, owing to cloudy weather.

It must be a mistake on the part of the Astronomer Royal (*Register*, August), that this phenomenon of Jupiter without satellites has only been seen *twice*. It seems to have been observed *four* times.—See Herschel, *Outlines*, p. 363 (5th edition).

I am, Sir, faithfully yours,

Teignmouth: Sept. 1867. G. T. WALKER.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I hope I may not be thought presuming if I trouble you with the facts which I and my brother observed on the interesting phenomenon of August 21.

I should not have ventured an opinion at all, but that I was surprised at the results printed in the correspondence referring to it in the September number.

In this correspondence, it seems to me that Mr. F. Bird was the only one who saw the real state of the case, namely, that the two extra dark spots *were not* the satellites, but that they were *beside* and *touched* the true satellites.

Our observation was as follows: On first looking, the first satellite was off the disc, but his shadow was on it; its transit was observed by my brother, who, while he was looking, remarked a fine shadow on the advancing side of the satellite, of a crescent shape and very narrow, the satellite being then only half on the planet's disc. Presently, I looked myself and saw this shadow; it was then wider and more plain (on account of being on a brighter part of the planet, whose edges fading rapidly in brightness cause the satellite to be very distinctly visible at first, but more faint as it advances on, and *vice versâ* with a shadow). It continued visible as distinct from both the true shadow and the true satellite as long as we observed. The same phenomenon I observed on the third satellite, which remained equally distinct from and yet in contact with the false pale shadow; the fourth satellite had no such shadow, neither was it at all visible. Thus there were the three true shadows and the two false ones, making five spots as observed.

I will not affirm that the satellites appeared to *occult* these faint shadows, only that, being quite in contact and long north and south, the conclusion is probable.

The only explanation I can find for all this is, that the first and third satellites *have atmospheres*, and that this pale shadow was in that atmosphere. The following seems to me incontrovertible: 1st, That they did not belong to the planet (for if so, on what could they be thrown?). 2nd, That they were not the satellites: in the case of the first I am quite confident; the third was more delicate, yet we saw it, and so did Mr. Bird. 3rd, They were not opaque, for they did not notch the edge of the planet.

The above conclusion, then, seems to me inevitable.

With this idea, I have examined the satellites separately, and have already obtained these results: September 4th, The third satellite had a vapour round it, absent on the fourth; the fourth a redder and lower colour than the third, (observed with 3¾ aperture). September 5th, The third satellite a clear disc, a halo probable; the fourth, *certainly* lower in tone and redder than third, showed a *clearer* disc. I made nothing certain about the double transit of September 6th, on account of the wind.

The questions to be settled, then, are these: Were these shadows too broad considering that they must be much foreshortened? Do these shadows always appear as belonging to the first and third satellites? Does the fourth ever have this false shadow? Have the first and third constant halos? Do the satellites have a constant characteristic difference in these respects.

The first question must be overruled if the others are all answered in favour of the atmospheric theory.

I omitted to say that the darker and redder colour of the fourth satellite is plainly the reason of his non-appearance on the planet's disc.

All these observations, except the one otherwise stated, were made with 6-inch aperture.

I anxiously await Mr. Dawes' letter, and have written before I see it, so that any observed coincidence may tell for its full value.

I hope I have not transgressed too freely upon your valuable space, and remain yours obediently,

The Cedars, Chiswick, W.: A. DAWSON.
Sept. 10, 1867.

JUPITER WITH ONE SATELLITE.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—On the 28th of August last, I had an excellent view of Jupiter in this condition. The third satellite, as it entered the disc of Jupiter, behaved precisely as it did on August 21, and became a dark body. I watched with my reflector, using a power of 119, this satellite's progress, and saw the gradual change from light to dark.

It entered the disc, and remained perfectly plain as a luminous body during its passage across the duller parts of Jupiter's margin, but soon after this, as it entered the stronger light of the planet, it faded rapidly and became dark grey, and finally brownish, and might easily have been mistaken for one of the shadows. This transformation was the more singular as the first satellite continued to shine with its pale light, without the slightest symptom of change, in front of its inky shadow, until clouds came on at 12.30, when no more was seen. The shadows and the dark satellite, at this time, had arranged themselves into the form of an equilateral triangle, —the latter being at the apex.

As during the present autumn, Jupiter will be well situated for observation, it is to be hoped the immersions and transits of the satellites will be carefully watched, with a view to ascertain the cause of these anomalous dark appearances, whether arising from dark spots on their surfaces, or from the mere effect of contrast; and also what proportion the dark transits bear to the luminous ones, and the order in which they occur.

I am, Sir, yours faithfully,

Birmingham: Sept. 12, 1867. F. BIRD.

JUPITER'S SATELLITES.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—In reference to a letter from Mr. Banks, in the number for September, I may say that I have often seen the third satellite of Jupiter with the unassisted eye, and when no other satellite has been near enough to produce any effect favourable to seeing it from the addition of light from the others. In fact, if the third satellite is distant a few diameters off Jupiter, I can generally see it. Not always, however. To test the matter, I have previously looked at Jupiter with the unassisted eye, and desired a friend to find it in the telescope, when my description of its position has agreed with its position in the telescope. And many times I have done as Mr. Banks did, *i.e.* looked first with the unassisted eye, and then tested the correctness of my sight with an instrument. At the same time, it is very probable that, in many of the recorded instances of visibility of a satellite with the naked eye, two or more have been juxtaposed, as in the cases which Mr. Banks cites. My own plan usually has been to look between the fingers of one or both hands, shifting them so as just to cut off the rays preceding and following in which positions the satellites always lie.

Another thing I have several times noticed—these little bodies are not always of the sizes as given in the order of Struve's measurements, viz. III. IV., I., II. I have repeatedly found IV. the smallest and palest of all. At other times II. has been superior to I. and nearly equal to III. These changes could not be accounted for by their juxtaposition with Jupiter. Has any one ever suggested a *law* for these changes? Will a rapid rotation (compared with the time of their revolutions) always agree with the phenomena which Secchi, Lassell, and others are said to have observed?

Possibly they may be invested with clouds as proportionately extensive as their primary has. If their variable light is occasioned always by the appearance of dark spots, may the latter not be temporary dark openings revealing a less reflective ground, and not merely the appearance produced by a regular rotation, revealing permanent *mares* to us?

What will explain, too, the appearance of III. as a *darker* spot on the disc of Jupiter than one of the *dark* belts of the latter, as no doubt many of your readers saw on the evening of the 21st of August, and several shades I thought from its visibility on that occasion, although in the open sky it generally is so brilliant? It seems to me that there must have been extensive spots really darker than Jupiter's belt.

Has any explanation been offered to account for the shadows of the satellites in transit being *larger* than the satellite itself, although irradiation would give entirely opposite effects?

Is it not possible that on so bright a background the penumbra is to us combined with the true shadow, and at present has not yet been distinguished from it (so far as I have heard), and thus the shadows appear larger instead of somewhat smaller?

Does Mr. Bird, in the extract from his letter respecting the appearance of Jupiter on the 21st of August, mean that he saw the satellites as *pale* objects in addition to the *extra dark* spots which he expresses himself at a loss to account for? Mr. Webb, in "Celestial Objects," mentions that Sir J. South once saw two shadows with two faint duplicates. Was Mr. Bird's a similar observation?

Yours truly,
T. H. BUFFHAM.

Earith, near St. Ives, Hunts:
Sept. 9, 1867.

THE ECLIPSE OF THE MOON LAST MONTH.

On the evening of the 13th of September the sky was beautifully clear and an excellent view of the eclipse was obtained. At Ramsgate, it was observed by the editor of the *Register* with a portable *Dollond* telescope of 2 inches aperture; nothing unusual was seen—the shadow towards the north-east of the moon's disc was very dark—and perhaps more of a lead colour on the whole than of the usual coppery tinge. At 12h. 4m. G.M.T. a small star was occulted by the moon close to the termination of the shadow on the east side.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The moon rose on the 13th inst. in a few light fleecy clouds. These quickly dispersed, and about 9 o'clock the sky became quite clear, promising us a good view of the eclipse, which was looked for and which commenced in less than an hour afterwards. This promise was amply fulfilled, for in the "plentiful lack" of fine nights we have latterly experienced, the night was remarkable for its clearness, the sky remaining absolutely cloudless for many hours.

Although the moon entered the penumbra of the earth's shadow at 9h. 43m. no change in its appearance was perceptible until 10h. 30m. About this time a slight shade was observed stealing over the moon from the N.E. quadrant. About 11 o'clock the moon's limb on this side became much darker. Three minutes before this it had entered the umbra of the earth's shadow; yet neither Mr. Baines nor myself, though we were both watching through telescopes, could detect the instant at which this stage of the eclipse began. The edge of the limb faded away—the obscurity kept increasing, and the shadow encroaching on the moon's disc—the flatness of the edge of this shadow, as compared with the curvature of the moon's limb when our luminary causes a solar eclipse, being very observable.

The shadow passed on till at 12h. 15m. it had obscured almost three quarters of the moon's disc, and then began passing off, melting away as gradually as it had appeared.

The whole surface of the moon was at all times to be made out, many of the markings within the shadow being easily visible. I noticed that some of the ray streaks, particularly the one proceeding from Bessel, entered into and were visible within the shadow. Linné shone very brightly until it was obscured by the shadow.

During the whole time the moon's limb, even the portion most deeply immersed in the earth's shadow, was *brighter* than any of the portions within the shadow that were nearer the centre of the disc.

Capt. Noble made a similar observation with regard to the visibility of the moon's limb on the occasion of the last solar eclipse.

The fact, however, to which I desire to call particular attention, and without observing which I should not have written this letter, is that, during the whole time of the eclipse, *the moon exhibited no other colours than those usually* seen on its surface.

I looked most carefully for colour, both with the 10½ silvered-glass reflector, furnished with an achromatic eye-piece of very low power, and also with a five-foot refractor; with neither could I detect a trace.

In all works that I have consulted I have found it stated that during an extensive eclipse the part of the moon in shadow is seen of a coppery red, while the line of demarcation between the umbra and penumbra of the shadow is almost blue. I appeal to some of your talented correspondents to support my assertion that in this instance no such colours were visible.

Apologising for the length of this communication,

I am, Sir, your obedient servant,

Upper Holloway: Sept. 16, 1867. JOHN BROWNING.

THE CRATER LINNÉ.

Seen in the Copenhagen Refractor. By Prof. SCHJELLERUP. (*Ast. Nach.* 1655.) Translated by W. T. LYNN, B.A., F.R.A.S.

THE notice on Linné published by Mr. Huggins in vol. xxvii., page 296, of the *Monthly Notices* which gives a not unimportant addition to a subject recently so much brought under discussion, leads me to mention that Prof. d'Arrest and I have carefully examined the crater with the large refractor at this Observatory, in the suitable and favourable evenings of April and May last. In particular Prof. d'Arrest has on those evenings seen the crater-opening, now visible in the middle of the large bright and somewhat diffused spot, exactly as Mr. Huggins has described and drawn it in the place referred to; only he estimated the diameter of the circular shadow at not more than 0″·9, at the most 1″·1; and the crater of very small depth. On the other hand, Huggins puts it at 1″·7. Moreover, it has not escaped our attention (and herein also we must quite agree with Mr. Huggins) that Linné presents, in Schröter's drawing, Tab. ix. (*v.*) in vol. i. of the Selenographical Fragments, in general about the same appearance as it does now in our large refractor; the description of the year 1788, at page 181, answers excellently to the present aspect. But this makes the results which we are now inclined to draw from the recent observations of Schmidt and others somewhat doubtful. It is true that Schröter himself did not notice the small crater-opening; but this is so difficult to perceive that no one acquainted with the nature of his telescope can wonder that it should be wanting in his drawing. Schmidt, who is known to be extraordinarily sharp-sighted, has indeed remarked, on two nights only—1866, Dec. 26, and 1867, Jan. 25—"an extremely fine black point." (Report of the Imperial Academy of Sciences at Vienna, part 2, February number for the year 1867, pages 8 and 9.) I do not touch here upon the difference between Schröter's drawing and the present appearance of the crater, as I have not specially occupied myself with the Moon's surface and the labours of Lohrmann, Mädler, and Schmidt upon the subject. Only I will just remark that the crater-opening is not near so striking as might be supposed from Mr. Huggins' drawing in the June number of the *Monthly Notices.*

Extract from a letter from Herr TEMPEL to the Editor of the *Astronomische Nachrichten.* Translated by W. T. LYNN, B.A., F.R.A.S. (*Ast. Nach.* 1655).

SOME time ago a friend communicated to me that he had read the observation of Herr Schmidt at Athens, that the Crater Linné in the Mare Serenitatis had disappeared. I endeavoured to see this crater in the Moon, and although the position of the terminator was not favourable—that is to say it was already broad day upon the Mare Serenitatis—nevertheless I easily found in that place a small white spot which surprised me not a little. I have indeed several times before, in Venice, drawn such white round spots; and in one case recorded the remark: "At sunrise projecting no form or great shadow, but in full illumination a white round spot, indicating a crater?"

I take the liberty of sending you an extract from a letter addressed by me last year, including some small drawings, to Herr W. R. in L., and leave it to you to make use of it, if you should think it of interest:—

"Marseilles, June 10, 1866 . . . I enclose a small unfinished sketch of Aristarchus, the white-glistening crater-surface of which will be known to you. But I have recently considered the Moon with attention—from two to five days after the conjunction—and found a remarkable light-appearance upon the dark side of the Moon, faintly illuminated, as is said, by the earth-light, which bright part agreed with the position of Aristarchus.

"I am aware that in astronomical observation one must be extremely on one's guard against optical deceptions. But this light-appearance has certainly not deceived me; for the light was not a faint white light, like that shown by other craters in the first days after the new Moon upon her dark side, but it was star-like, diffused, in colour reddish-yellow, certainly different from all the other visible bright spots. Of course I am far from surmising a still active volcanic outbreak, as such an outbreak supposes water and atmosphere, both which are universally allowed not to exist in the Moon—so that the crater-forming process can only be thought of as a dry, chemical, although warm one.

"But it is certain that, if we suppose and consider probable a still-existing activity in changes of separate parts on the moon, we have but very scanty means of recognising and proving this.

"As the moon, so to speak, completed for some thousands of years, is perfect as a whole, the first means of recognising a still-existing activity would consist only in the perception of small changes of form in particular craters or mountains, which we could see under direct solar illumination; but in this ordinarily very many negative cases present themselves, and for a long time will continue so to do, whilst we possess, as our single basis of comparison, the celebrated map of Beer and Mädler. Every careful observer will find hundreds of such negative cases, namely, a multitude of small craters, also apparently altered forms of particular mountains, which are either not given, or are given differently, upon Beer and Mädler's map; but this is no ground for assuming these things to be *newly formed.* Even a more beautiful and more accurate map cannot lay claim to be the best and last. What wonderful changes of form do not the different degrees of illumination often show during the course of a few hours! For example, on my sheets Nos. 1 and 5, between Mairan and Delisle, the same regions are so unlike that, if I had not drawn them myself, I should scarcely believe them to be the same drawn by another hand. So that positive results, that is, of things certainly seen and drawn by different observers, which later observers have no longer found, could not be reached until after many years, when the basis of comparison shall have furnished a larger material. (The observation of Herr Schmidt is, up to the present time, the first positive result of a change or indication of activity upon the moon.)

"The second possibility, that of observing a volcanic, chemically warm action upon the moon, can only be afforded by the dark side of the moon, or that not directly illuminated by the sun, as a luminous activity could only be seen shortly before or after the new moon; for the direct rays of the sun would make it perfectly impossible to see the greatest fire from the earth, since, there being no atmosphere, there can also be no smoke, which might indicate to us a fire in the illuminated part of the moon.

"*I would call the attention of future observers to the round white spots* (not those bright streaks which at full moon are seen to proceed in all directions from Tycho, Kepler, and other craters); *these white round spots are, in my opinion, of interest for a chemically warm activity.* They have at the sunrise upon them but very little or no shadow, and then appear like *small bubbles.* As instances, for recognition, I adduce two places only: between Delisle and Diophantus, and on the right-hand side of Arago.

"Should my above-mentioned observation be so far confirmed that that reddish yellow appearance of Aristarchus upon the dark side of the moon should again be seen, and should it at the same time be proved that it is no light appearance of a chemically warm activity, it might then be asserted that the moon must possess a kind of atmosphere, which, during the moon's night, gave, by refraction of the sun's rays, a yellowish light to Aristarchus, which has a bright white brilliancy by day."

On the 7th of May this year, I had the first opportunity of showing this phenomenon to a learned gentleman of this place, Mons. Dethon, then at my house, who, when I had brought the bright moon's crescent out of the field of view, immediately detected this brilliant point, and recognized its colour, as I had often seen it. The magnification used upon my 4-inch telescope was one of 120 times.

Marseilles: May 20, 1867.

Tempel afterwards wrote the following short note to the *Astronomische Nachrichten*, under date July 28, 1867. I send it you, like the rest, rendered into English, but *for the present* without comment.—W. T. L.

Note by Tempel (*Ast. Nach.* 1656):

"I observed the crater Linné on the 22nd of July. It appears as if the small crater was filled up: nay, there is now a small elevation, a small round conical hill in its place. The power used was 300, and the night very clear."

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

SEPARATION OF THE STARS COMPOSING γ ANDROMEDÆ.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—It seems to me that Mr. Darby must have overlooked the statement at the close of my paper in the *Astronomical Register* for March, that the subjoined diagrams of γ *Andromedæ* and δ *Cygni* were "drawn to a scale." There can, therefore, be no mistake in the relative distances of the components arising from error of estimation by the eye.

From some previous measurements, I assumed the diameter of the disc of γ *Androm.* to be about 1″·5. Then, taking the central distance between A & $\frac{B+C}{2}$ at 10″·5, that distance equals about 7 diameters of A. On referring to my original diagram, I find that this proportion is adhered to as nearly as could reasonably be expected; but in the wood engraving the distance is rather more than 7 diameters, the diameter of A being a trifle too small.

The engraving in Mr. Darby's letter in the *Astronomical Register* for

August cannot surely have any pretensions to accuracy of proportions; for the central distance of A & $\frac{B+C}{2}$ is only about 2·7 A, and therefore $A = 3''\cdot 9$, which would be the diameter of the disc with a refracting aperture of about 8 inches only.

I have often noticed the tendency, in myself as well as in others, to depict the distances of stars much too small in proportion to the diameters of the components, when the stars are bright and the distance equal to several diameters of either. I believe that this arises from the rings which surround bright discs: these encroach on the vacant space between the discs, and give the impression of a smaller vacancy in proportion to the disc.

Mr. Darby observes that he "has very little faith in either diminishing aperture caps or perforated zink discs" in aiding the separation of close stars. Though the two methods are here put together, it is evident that their effects must be very different, and, in fact, of opposite kinds. A diminished aperture produces a larger disc; *not*, indeed, in *exact* proportion, because, the light being less, the very edge of the disc becomes invisible from want of light, thus diminishing what would otherwise be the apparent disc. From the same cause, a perforated whole aperture has the advantage of presenting a disc somewhat *smaller* than would be produced by the whole unobstructed aperture, in consequence of the greatly diminished quantity of light. Thus, then, especially on bright and very close stars, the separating power of a large object-glass is considerably increased.

In the number of the *Register* for the present month, Mr. Darby has adverted to the case of μ *Boötis*; and in the first paragraph of his letter he explains the position of the components of γ *Androm.*, as given in the diagram attached to his letter in the number for August. It is obvious, however, that, if the engraving is correctly placed, instead of "*after* the meridian passage," we should read "*before* the meridian passage."

In the following paragraph, Mr. Darby says, "μ^2 *Boötis* is, in my estimation, a closer star than γ^2 *Andromedæ*, arising, as I think, from the following circumstances." In what way the greater closeness of μ^2 can "*arise*" from the circumstances named, perhaps the author may explain hereafter.

But the most extraordinary and alarming part of that letter is the impeachment of Sir W. Herschel's accuracy in stating that between 1782 and 1802 the smaller star of μ^2 *Boötis* had changed its direction from the following to the preceding side of the line joining μ^1 and μ^2. Though I should hope there are few of your numerous readers who would agree with the verdict, it may be well to see how the case really stands.

Referring to the three stars as A, B, and C, in the order of brightness, Sir William stated that C was, in 1782, on the *following* side of the line joining B and A, and that, in 1802, C was on the *preceding* side of the same line.

In 1821, by the measures of H. and S. (which Mr. Darby has erroneously interpreted as meaning "Sir William Herschel and S."), the position angle of A B was 171°·85. Consequently, the line B A would be in the direction 351°·85.

By H.'s measures, the position of B C, in 1782·68, was 357°·23. Hence the direction of C from B *followed* the line B A by 5°·38.

In 1802·66, the position of B C was 346°·23, and the direction of C from B *preceded* the line B A by 5°·62. It follows that the direction of B C *really had changed sides* from 5°·38 *following* to 5°·62 *preceding*, though the variation of the angle in the 20 years was only 11°·0. Where, then, is Sir William Herschel's "nodding"?

What Mr. Darby can possibly mean by making the "*really changing sides*" equivalent to "*making the revolution of two whole quadrants,*" must be left to himself to explain; but, in the meanwhile, he must excuse those who fancy that the "nodding" must have been rather profound when that idea was dreamt of.

The "eye-sketch" of μ^1 and μ^2 *Boötis* which is attached to Mr. Darby's letter in this month's *Register* is a remarkable instance of the neglect of the true proportions in such sketches. The central distance of B C is about 0″·55. The distance of B from A is about 108″, or 196 times the central distance of B C. In the diagram, the distance of B from A is about 5½ times the central distance of B C. But how few, in making an eye-sketch, would give it the true proportion, even if it were aimed at!

I remain, faithfully yours,
Hopefield Observatory, Haddenham, Bucks: W. R. DAWES.
1867: September 14.

P.S.—With respect to Mr. F. Bird's account of the "meteor-like bodies seen near the sun," I would beg to refer your readers to my description of such a shower given in the *Monthly Notices* of the R.A.S. for April 1852.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—On reading over my letter again on μ^1 and μ^2 Boötis, published in the *Astronomical Register*, it struck me that the language of Sir William Herschel, in the quotations I gave from "Smyth's Cycle," was very ambiguous, and might possibly have been used in a sense different from that in which I understood it. The following is the sentence:—"In 1781 it was remarked by Sir W. Herschel that the small star (μ^3) followed the line joining the large one to μ (μ^1 and μ^2), and in 1802 that it had changed sides and preceded the same line." The natural meaning here seems to be, that the small star followed on the same line that joined the other two stars, and that all three stars were in a line in 1781, and by the small star "changing sides" by 1802, I understood it had accomplished a semi-revolution of 180° up to that time. It may be, however, that Sir W. Herschel used the words *follow* and *precede*, not in their usual signification, but in reference to the course of μ^3 in its orbit around μ^2, and that he meant by the expression "changing sides," not performing half a revolution, but *changing quadrants*, or crossing over the imaginary line which joined μ^2 to μ^1. If this be the true meaning of the language imputed to Sir W. Herschel in the above-quoted observation, then it follows that I have altogether misunderstood him. The error is mine, not his; and this conclusion, I confess, is all the more gratifying to me. It is no small satisfaction to find that though the Prince of Poets did sometimes *nod* over his verses, the Prince of Astronomical Observers was always *wide awake* whenever the interests of his noble science were concerned.

Chorlton Hall, Manchester: Very truly yours,
Sept. 12, 1867. W. A. DARBY.

THE NEW MINOR PLANET.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The newly-discovered planet has received the name of Undina, of which Dr. Peters remarks that it is perhaps not to be found in the old classics, but it is at least classically formed, and has become famous by the delightful poetry of De la Motte Fouqué. He has obtained the following first elements of the orbit, for 1867, January 0:—

	° ′ ″
Mean anomaly	295 0 56
Longitude of perihelion	345 44 55
Longitude of ascending node	103 38 46
Inclination	10 16 49
Excentricity	0·10273
Period	2093 days
Semi-major axis of orbit	3·2028

I am, Sir, yours faithfully,
W. T. LYNN.

Greenwich: 1867: August 27.

REFRACTION ACCORDING TO MR. HICKSON.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Mr. Hickson has made an appeal to your readers. I will finish the controversy, so far as I am concerned, by doing the same thing.

Mr. Hickson says, what nobody denies, that the external surface of the atmosphere is convex. Has it ever occurred to him that the internal surface is *concave* and parallel to the exterior one? A section of any considerable portion of our atmosphere must resemble either fig. 1 or fig. 2 (in which the shaded part represents the earth's surface).

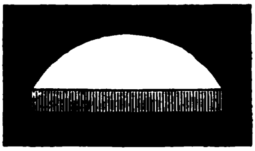


Fig. 1.

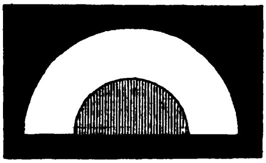


Fig. 2.

If the former be the case, I can only express my regret that I have hitherto so misunderstood the rudiments of Physics; but if the latter, then I would humbly inquire of every one who may have perused this correspondence, whether Mr. Hickson has not been under a misapprehension throughout?

I am, Sir, yours very obediently,
N.

August 2, 1867.

The Sailor's Word-Book, by the late Admiral Smyth, is announced for publication on the 1st instant, by Blackie and Son. This is the work the Admiral was engaged upon close up to the time of his death: it has been prepared for the press by Admiral Belcher.

ASTRONOMICAL OCCURRENCES FOR OCT. 1867.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon
Tues	1	 0 10	Sidereal Time at Mean Noon, 12 38 59·9 Conjunction of Moon and Saturn, 2° 56′ S.	2nd Sh. I. „ Tr E. „ Sh. E.	6 16 7 26 9 8	— 2 43·2
Wed	2		Meridian passage of the Sun, 10m. 33s. before Mean Noon	4th Ec. R.	8 38 17	3 31·0
Thur	3			3rd Tr. E. „ Sh. I. „ Sh. E.	7 51 7 52 11 29	4 18·8
Fri	4					5 6·5
Sat	5	6 17	☽ Moon's First Quarter	1st Oc. D.	12 15	5 54·0
Sun	6			1st Tr. I. „ Sh. I. „ Tr. E. 2nd Oc. D 1st Sh. E.	9 25 10 22 11 44 12 2 12 42	6 41·2
Mon	7			1st Oc. D. „ Ec. R.	6 42 9 57 32	7 28·1
Tues	8			1st Tr. E. 2nd Tr. I. 1st Sh. E. 2nd Sh. I. „ Tr. E. „ Sh. E.	6 11 6 56 7 10 8 55 9 49 11 46	8 14·6
Wed	9	3 57	Conjunction of Moon and Jupiter, 2° 49′ S.			9 0·9
Thur	10	12 8 14 53 15 48	Near approach of Moon to φ Aquarii (4½) Occultation of 96 Aquarii (5½) Reappearance of ditto	4th Tr. I. 2nd Ec. R. 3rd Tr. I. 4th Tr. E. 3rd Tr. E. „ Sh. I.	5 29 6 3 22 7 44 10 7 11 22 11 53	9 47·5
Fri	11					10 34·7
Sat	12	12 53	Conjunction of Mars and α² Libræ, 6m.·8 E.			11 23·0
Sun	13	1 24	○ Full Moon	1st Tr. I. „ Sh. I.	11 13 12 18	12 12·9
Mon	14	11 33 12 32	Occultation of B.A.C. 830 (6) Reappearance of ditto.	1st Oc. D. „ Ec. R.	8 31 11 53 10	13 4·9
Tues	15	7 38 7 45	Occultation of *f* Tauri (4) Reappearance of ditto	1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E. 2nd Tr. I. „ Sh. I. „ Tr. E.	5 40 6 46 8 0 9 6 9 22 11 34 12 15	13 59·3
Wed	16	 7 25 8 9 7 33 8 0 7 55 8 36	Sidereal Time at Mean Noon, 13 38 8·2 Occultation of θ² Tauri (4½) Reappearance of ditto Occultation of θ¹ Tauri (4½) Reappearance of ditto Occultation of 80 Tauri (6) Reappearance of ditto	1st Ec. R.	6 22 7	Jupiter — 8 22·1

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Jupiter —
Wed *continued.*	16	8 6 8 51 8 33 9 27 8 35 10 55 12 20	Occultation of 81 Tauri (5½) Reappearance of ditto Occultation of 85 Tauri (6) Reappearance of ditto Near approach of Moon to B.A.C. 1391 (5) Near approach of Moon to Aldebaran (1) Near approach of Moon to σ^2 Tauri (5½)			
Thur	17	8 11 16 4 17 14	Occultation, reappearance of 117 Tauri (6) Occultation of 130 Tauri (6) Reappearance of ditto	2nd Ec. R. 3rd Tr. I.	8 39 21 11 20	8 18·1
Fri	18	13 10 14 7 23 7	Occultation of 26 Geminorum (5½) Reappearance of ditto Conjunction of Moon and Uranus, 4° 51′ N.	4th Oc. D.	11 37	8 14·1
Sat	19	10 45 21 17	Conjunction of Mars and Mercury, 1° 56′ S. ☾ Moon's Last Quarter			8 10·1
Sun	20		Meridian passage of the Sun 15m. 5s. before Mean Noon			8 6·1
Mon	21			3rd Eo. D. „ Ec. R. 1st Oc. D.	5 54 10 9 19 33 10 21	8 2·1
Tues	22			1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E. 2nd Tr. I.	7 30 8 42 9 50 11 1 11 50	7 58·1
Wed	23			1st Ec. R.	8 17 48	7 54·2
Thur	24			1st Sh. E. 2nd Oc. D. „ Ec. R.	5 30 6 2 11 15 31	7 50·2
Fri	25					7 46·3
Sat	26			2nd Sh. E.	6 22	7 42·4
Sun	27	1 3 15 40 18 25	● New Moon Conjunction of Moon and Venus, 4° 0′ S. Conjunction of Mercury and δ Scorpii, 14m. 2s. E.	4th Sh. I.	9 21	7 38·5
Mon	28	10 38 14 22 21 15	Conjunction of Moon and Mars, 5° 14′ S. Conjunction of Moon and Saturn, 3° 0′ S. Conjunction of Moon and Mercury, 7° 51′ S.	3rd Oc. D. „ Oc. R „ Ec. D. 1st Oc. D.	4 46 8 25 9 56 22 12 13	7 34·6
Tues	29			1st Tr. I. „ Sh. I. „ Tr. E.	9 22 10 37 11 41	7 30·8
Wed	30			1st Oc. D. „ Ec. R.	6 41 10 13 31	7 26·9
Thur	31	9 29 15 3	Mercury's greatest easterly elongation, 23° 26′ Conjunction of Saturn and Mars, 2° 18′ S.	1st Sh. I. „ Tr. E. „ Sh. E. 2nd Oc. D.	5 6 6 9 7 25 8 31	7 23·1

THE PLANETS FOR OCTOBER.

Mercury sets after the Sun during October, and may be seen for a shrot time during the evenings at the end of the month, his greatest easterly elongation taking place on the last day.

		h.	m.	s.			°	′		
1st	R.A.	13	12	37	Decl.	−	7	44½	Diameter	4″·8
15th	„	14	31	41	„		16	38½	„	5″·3

Venus also sets shortly after the Sun, but she is too close to him to be well observed.

1st	R.A.	12	36	28	Decl.	−	2	32½	Diameter	9″·6
15th	„	13	41	6	„		9	28½	„	9″·6

Illuminated portion of the disc of Venus, 0·996.

Mars and **Saturn** set too closely after the Sun to be well seen.

Jupiter remains the most conspicuous object in the evening sky, setting about 2 o'clock in the morning at the beginning, and about midnight at the end of the month.

1st	R.A.	22	4	35	Decl.	−	13	13½	Diameter	47″·4
15th	„	22	1	44	„		13	27	„	45″·9

Neptune is favourably situated for observation.

4th	R.A.	0	53	11	Decl	+	3	54½
16th	„	0	51	57	„		3	47

BRIEF CORRESPONDENCE.

REFLECTORS.—If J. L. has access to the *Monthly Notices* of the Royal Astronomical Society, he will find the Rev. H. C. Key's method described by him at p. 199 of the 23rd volume (for 1863). I have just read it, and it is a very lucid account of the mode of procedure. T. H. W.

THE MONTHLY NOTICES.—I find in your August number a statement that the *Monthly Notices* are sold to the public at five shillings per volume. Does this mean that any person can buy them? I thought only fellows could get them. Are they to be got from the printer, or direct from the Society's Editor? T. H. W.

THE BEDFORD CATALOGUE.—Could you inform your readers if there is any likelihood of a new edition of this work appearing soon?

SUBSCRIBER.

THE PLANET VULCAN.—When ought the passage across the sun of the newly-discovered planet *Vulcan* to be looked for? Information as to the above would oblige many besides myself. A SUBSCRIBER.

METEORS.—Would some one versed in the matter have the kindness to inform me by what means observers of meteors arrive at their (supposed) height, distance, angle of inclination, and velocity? All these I see spoken of as ascertained, from time to time, and I should be thankful for a hint as to the mode in which I might make similar observations.

A GAZER.

Astronomical Biography.—I know of no such work, and feel sure that one does not exist. Materials for one may be found everywhere, but especially in the *Monthly Notices*, Bailly's *Histoire d'Ast.* and *English Cyclop.* Grant's so-called History of Astronomy might be excelled by a very moderate literary effort. C.

The Sun and Moon.—Ignoramus asks how often the sun turns round to the moon. What does he mean? How often in a year, or a hundred years, or what? The sun turns on its axis: he may, by taking the trouble of consulting any reliable astronomical work, readily find out how many times in a year. D. C.

In regard to Ignoramus's query, I entreat you not to waste any more space on this interminable subject. G. F. C.

INSTRUMENTS, &c. FOR SALE.

These Notices, which are restricted to *two lines* each, are inserted free of charge to subscribers: applications respecting prices and other particulars to be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—For Advertisements with prices and more complete details, a small charge will be made.

N.B.—It is particularly requested that we may be informed when instruments are disposed of, in order that the notice may be withdrawn, and fruitless applications prevented.

Achromatic Refractor, 6·4 in. ap. 8½ ft. focus, by *Merz*, Equatorial and clockwork by *Troughton & Simms.* [73]

Achromatic Refractor, 4½ in. ap. by *Alvan Clark*: equatorially mounted; no circles. Powers to 450. [110]

Achromatic Refractor, 4 in. aperture, by *Cooke & Sons*; equatorially mounted, complete in every respect. [104]

Achromatic Refractor, 4 in. ap. 5 ft. focus, by *Dollond*; equatorially mounted. Powers up to 400. [87]

Achromatic Refractor, 3¼ in. ap. 50 in. focus, with brass tripod, comet, landscape, and 4 other powers 74 to 260. [111]

Gregorian Reflector, 4¾ in. ap. 2 ft. focus, by *Dollond*, 4 powers, 50 to 200, finder, &c., on brass table stand. [63]

Achromatic Object-Glass, 4⅛ in. ap. 62 in. focus, by *Slugg*, with brass cap and receiving cell, for mounting on tube. [85]

Transit Instrument, 3¾ in. ap. 5 ft. focus, Ys fitted with agates for mounting on stone piers. [29]

Transit Instrument, 2¾ in. ap. 30 in focus, by *Troughton & Simms*, with micrometer eye-piece and cast-iron adjustible stand. [107]

Equatorial Stand, for 5 ft. telescope: with circles, &c. complete. [99]

Equatorial Stand, for a 5 or 6 ft. telescope: 13 in. circles, divided on silver, to 10″ of space and 4s. of time.—Has never been used. [55]

Polar Axis, of mahogany, 7 ft. long, adapted for a 4 ft. telescope, with 12 in. circles, reading to minutes. [56]

Right Ascension and Declination Circles, 10 in. [109]

Speculum Grinding Apparatus, capable of working a 7 ft. speculum: with tube and fittings for a 9 in. Newtonian. [57]

Astronomical Clock: zinc and steel compensation; price low. [114]

Recreative Science: and the first three volumes of the **Photographic Journal:** price very low. [30]

Lalande's Astronomy, 2 vols. 4to. [108]

INSTRUMENTS, &c. WANTED.

Astronomical Clock, not very first-class; price low. [65]
Equatorial Stand, for a 5 ft. Refractor: graduated circles. [85]
Garden Stand for 8 ft. Achromatic; price low. [112]
Brass Tripod for a 2 ft. Telescope: condition not material. [106]
Transit Instrument, 2 in. ap. 18 or 24 in. focus. [71]
Transit Instrument, 1½ in. aperture, about 20 in. focus. [102]
Monthly Notices of the Royal Astronomical Society, Vol. 3. [26]
Monthly Notices: Vol. 5, No. 12. [82]
Bartholomew Prescot on the Universe, published 1823: a copy wanted, in good condition. [84]
Galbraith's Mathematical and Astronomical Tables, 2nd edition. A good price will be given for a clean copy. [105]

The Meeting of the British Association has been held this year at Dundee, under the presidency of the Duke of Buccleuch. The report from Kew Observatory of the work done by the photo-heliograph, under the direction of Mr. De la Rue (at whose expense the researches have been printed); the report of the Lunar Committee; an account of the progress of research and observation with regard to meteors; with some references to meteorological science with a view to the resumption of the storm warnings;—these have been the principal points of interest connected with the science of astronomy, their details being known to many of our readers. The next meeting is to be held at Norwich, under the presidency of Dr. Hooker.

LIST OF SUBSCRIBERS—Name received since our last number.

W. Smurthwaite, Esq., 66 Gilesgate, Durham.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To September 1867.
Linwood, Rev. W.

To December 1867.
Buffham, T. H.
Garnett, W.
Petty, T.
Shawcross, W.
Smurthwaite, W.
Vertu, J.

To March 1868.
Alsager, J.

To April 1868.
Knobel, E. B.

To June 1868.
Green, J.
Main, Rev. R.

To December 1868.
Simkiss, T. M.

Sept. 17, 1867.

NOTICES TO CORRESPONDENTS.

Several letters remaining unanswered will be attended to by the Editor on his return to town.

D. A. B. Our correspondent's letter was received after the *Register* was made up, but he will see that its object has been answered.

Correspondents communicating with the Editor are particularly requested to notice the change in the address to Parnham House, Pembury Road, Clapton, N.E., instead of Stamford Villa, as heretofore.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 59. NOVEMBER. 1867.

THE NOVEMBER METEORS OF 1867.

With the recollection of the grand display of meteors on the 14th of November last year still fresh in the minds of our readers, it is not surprising that great interest should be taken in its probable recurrence in the present year. The circumstances will, however, be very different, and, as far as we are concerned in this country, very little is likely to be seen of this interesting occurrence. From a letter of Mr. A. S. Herschel's, which has appeared in the *Times*, we gather that this particular star-shower has constantly increased since the year 1863. In 1865 about 2,000 meteors were seen on the 14th of November at Greenwich, and in the great shower of last year about 8,000 were counted. They have not, however, yet amounted to the celebrated spectacle seen by Humboldt in South America in the year 1799, or by another observer in North America in 1833, who describes them as falling "about as thick as the flakes of snow in common snow-falls;" or by another, who relates that "their number seen at once often equalled the number of the fixed stars seen at a glance." Relying on the evident periodicity of the phenomenon, Olbers predicted their return in the present year, or at an interval of 34 years. This interval has now elapsed; and the star-showers last year having returned in the same abundance and in the same places as in 1832, it may be confidently expected that another star-shower will appear this year in America, similar to that of 1833. At about six o'clock in the morning, Greenwich time, on Thursday, the 14th of this present November, the earth will occupy the place in which it encountered the meteoric shower last year. It will cross the central line about half-past seven, a few minutes before sunrise, and about nine o'clock, when the sun is fairly up, the rain of fireballs will cease. Observations should, however, be made on the mornings before and after the expected date, and at intervals during the night of the 13th and morning of the 14th, as the time of these appearances cannot be absolutely fixed.

Although the star-shower, from the approaching daylight, will be only partially visible in Great Britain, it will be well seen in Canada and North America, as darkness will prevail there during the whole time which corresponds to the duration of the shower last year. Nevertheless, as the meteors of 1799 were partially seen at Hull in England, and those of 1833 were noticed at Weimar in Germany, it is not quite impossible that a slight view may be obtained of the present shower in this country. Even on the continent, where the circumstances are less favourable, some tokens of the star-shower may probably be seen.

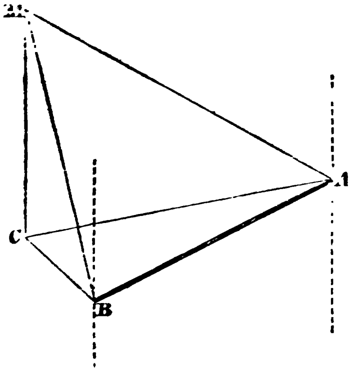
CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

NOVEMBER METEORS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The information sought by "A Gazer"* concerning meteors is of a purely trigonometrical character, and being of the simplest kind, a mere outline of the method of proceeding will be sufficient, I trust, to satisfy him.



Two persons, at A and B, observe the commencement of a meteor's path at M, and from their observations are able to determine the altitude and azimuth of the point. Let C be the point on the earth's surface immediately under M, and complete the figure. Now, if on a good map the two azimuths be laid off with a protractor, the point C will be immediately obtained, together with its distance from A or B, and with these distances, and the observed altitudes (combining, of course, the altitude and distance proper to each point), the height M C is readily found by adding the logarithm of the distance to the log. tangent of the altitude, or by projecting the triangles.

Similar observations by the same or different observers determine the position of the terminal point.

The curvature of the path must be carefully estimated from a comparison of all the observed apparent paths, as actual observed co-ordinates of the middle point cannot be expected unless the path extend over a large portion of the heavens.

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* See page 226.

The altitude and azimuth are best obtained by noting the exact position of the beginning and end among the stars and the time by a watch. The error of the watch on *local*, mean, apparent, or sidereal time should be found as soon as possible after the observation, in order that a celestial globe may be accurately set to position of the heavens at the time of observation; the two observed points among the stars being then marked on the globe, the altitudes and azimuths can be taken off.

A very simple little instrument was described some time ago, I think in the *Monthly Notices*, by Mr. A. S. Herschel, for observing altitudes nearly in the dark, but one never has an instrument in his pocket when he sees a meteor. The appearance of one beneath a stratum of cloud is extremely rare. In such a case it must be very near the earth, and its altitude, if carefully estimated, would be valuable. The azimuth is pretty accurately obtained in all cases by noting some terrestrial object, not too near, immediately under it, or by marking the ground.

Anyone making an observation of this kind, which he considers fairly reliable, should unhesitatingly publish it; and if he only observe the end, as is most often the case, he should describe the portion of the path he did see.

The information in such a communication should contain—

The time,
The altitude and azimuth, or
The place among the stars, and
The description of the path and appearance of the meteor.

As many may observe remarkable meteors who cannot reduce their observations, either from want of time or inability, I shall be very happy to receive any such observations from anyone, with a view to reducing and publishing them. I am, Sir, your obedient servant,

Eastney Barracks, Southsea : G. L. TUPMAN,
October 7, 1867. Captain R. M. Artillery.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—It is very desirable that as many observers as possible in different localities should be armed with proper appliances for observing the meteors, the appearance of which is anticipated on the morning of the 14th of November.

I beg therefore to suggest, that it is desirable for you to communicate with those of your subscribers or contributors who are acquainted with the most recent modes of spectroscopic research as applied to meteors, and obtain from them a description of the best and cheapest spectroscopes, the names of their makers, by whom and at what price they are sold, and how they may be most effectively used. This information should be given in the November *Register*, in order that its readers may have an opportunity of supplying themselves with the requisite appliances, and have a few days for practice in their use.

Permit me to suggest to your readers the desirableness of making special efforts during the next November meteoric shower to fix the exact courses of the more prominent meteors, the precise times of their occurrence, and the exact position over which they burst or disappear.

I am, yours obediently,
T. P. BARKAS.

Newcastle-on-Tyne: Oct. 7, 1867.

JUPITER'S SATELLITES—DOUBLE STAR POSITIONS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—A postscript to my letter in the last *Register* contains a notice of the peculiar appearance of the shadow of II. when in transit. An opportunity of repeating the observation occurred on October 1, when, according to the *Nautical Almanac*, the shadow of II. entered on the disc of Jupiter at 6h. 16m., and left it at 9h. 8m. P.M. The satellite itself was just emerged when I began observing at 7.30. I was surprised that I could not find the shadow with a power of 100, when the Barlow lens was applied, which increased the power to about 150. It was very minute; in fact barely visible: 220 showed it best. I was astonished at its minuteness; it was very hazy and ill-defined, though the planet's belts were superbly visible.

As a contrast to this may be mentioned the transit of the shadow of III. on October 3. The satellite was not visible till it emerged at 7.51, immediately after which the shadow was perceived breaking in on the opposite limb; it was intensely black, well-defined, and visibly oval—evidently the effect of foreshortening near the limb; as it neared the centre it became circular, and was superbly seen with power 150 on the 6½-inch reflector.

Seeing in the *Register* the correspondence on the estimating of position angles of double stars, reminds me that many of the errors of your readers would be avoided, by adopting a simple contrivance which I have successfully used with my 3-foot achromatic 2-inch aperture, and which is described in the *Intellectual Observer* for January 1866 as a substitute for the position micrometer. For the benefit of those who do not see this valuable periodical, it may be simply described as a graduated circle attached to the eye-end of the telescope, on which revolves a steel index, affixed to the eyepiece and turning with it. A cross-hair being placed in the focus of the eye-lens, the larger of a pair of stars is made to run along this in its passage across the field of view, and the degree marked by the index gives the direction of the line of declination, or the points 90° or 270°; then on revolving the eye-tube till the hair exactly bisects the two stars, the angular position with regard to either of these two points is at once known, and from this the position with regard to the meridian can be easily ascertained. A few measures are appended as samples of what may be done with such a contrivance:—

			°					
1	γ Arietis . .	Pos.	358·7	Measures	4	Epoch	1865	Nov. 3.
2	δ Orionis		357·1	„	5	„	1866	March 14.
3	γ Virginis		165	„	4	„	„	April 19.
4	β Scorpii		22·3	„	4	„	„	June 25.
5	ν Scorpii		339	„	4	„	„	June 24.
6	γ Delphinus . . .		271	„	4	„	„	July 14.
7-178	PXX Delphinus		256	„	3	„	„	July 22.
9	s Aquarii		341	„	3	„	„	Aug. 22.
10	λ Arietis		42·7	„	5	„	„	Sept. 21.
12	τ Tauri		213	„	4	„	„	Oct. 28.
13	Castor		231·5	„	12	„	„	Nov. 11.
14	118 Tauri		198	„	2	„	„	Dec. 11.
15	γ Leonis		108·5	„	5	„	„	March 10.
16	12 Canes Venatici .		227·2	„	4	„	„	March 2

Apologising for the length of this communication,

I remain, yours very truly,

Town's End Road, Chesham, Bucks: CHARLES GROVER.

October 11, 1867.

DARK TRANSITS OF JUPITER'S SATELLITES.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—On the 10th of October I saw the very interesting phenomenon of two of Jupiter's satellites, as dark spots, on his disc at once. I did not see the ingress of IV. at 5.29, but at 7 it was distinctly visible as an almost *black* spot, having then nearly completed half its transit. III. was now shining near to the following limb of Jupiter,— a rather bright point, but much smaller than it usually is when at some distance from Jupiter. At 7.44 it commenced its transit. As it was passing on to Jupiter, its preceding edge seemed bordered by a narrow crescent-shaped shade, probably the dark-shaded limb contrasted against the more vivid light of the satellite. The deficiency of this limb of Jupiter is now strikingly seen when compared with the fully illuminated opposite limb. The greater shade may be caused by twilight at the terminator. I could only trace III. for a short distance as a *bright* spot. When about one-third of the diameter of Jupiter from the limb, I suspected it was changing to a *dark* spot. This was confirmed soon after, and when near the centre it was distinctly seen, though not so dark, and perhaps not so large, as IV. The latter was skirting the uppermost of two narrow dark belts together forming the usual principal southern belt. III. was lower—perhaps on the lowermost of the two belts above mentioned. I thought III. now appeared larger than it appeared previous to its ingress. IV. was now approaching the preceding limb of Jupiter. It could not be well seen when about to commence its egress, and when it should have been outside the limb it was scarcely visible. At 10.15 it was seen as a very small point, only about one-third of its diameter when previously on Jupiter, very dim and indistinct.

Mr. Dawes's excellent observation given in the October number of the *Register* will account for III. appearing as a dark spot in inferior instruments. As to IV., whenever I have seen it shining in the sky during the present appearance of Jupiter, it has been as a very small, usually pale, irregular-looking spot, often inferior to I. or II. Struve measures it only one-seventh less than III., and the latter about 1½ times larger in diameter than I. and II. Suppose the surface of IV. to be some dark substance, yet of a certain degree of reflectiveness, it appears that it would only be seen as a *dark* spot when projected on to the brighter disc of Jupiter; but when exterior to him, it would appear as a *smaller* spot, because of the light being reflected only from its *central* parts with sufficient intensity to appear bright against the sky.

I can confirm Mr. Grover's remark in his postcript respecting the ill-defined appearance of the shadow of II. My observation was made August 12.

Evidently these moons are much unlike ours, unless—which is difficult to conceive—the side we never see is totally different from her visible face. The latter would never appear other than a uniformly luminous disc at the distance of Jupiter. The accumulation of careful observations is most desirable.

The instrument used as above was a 3-inch refractor; the most effective power was 110.

Yours truly,
T. H. BUFFHAM.

Earith, near St. Ives, Hunts:
October 12, 1867.

LANGUAGE OF SIR W. HERSCHEL, ETC.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I shall be obliged by your permitting me to inform your readers that in my letter in the number of the *Astronomical Register* for this month, on page 221, there is a typographical error which materially interferes with the truth of the statement referring to the diameter of the disc of γ *Andromedæ*, deduced from Mr. Darby's diagram. In line 3, instead of "$A = 3''\cdot 9$, which would be the diameter of the disc with a refracting aperture *of about 8 inches only*," it should be, "*of about 3 inches only*."

Also on p. 210, l. 4, above the sketch of the third satellite, for "reminded one forcibly," read, "reminded me forcibly."

I am unable to corroborate the coloured appearance of the satellites on Jupiter's disc, and of his belts, noticed by Mr. Barneby; which I imagine must have arisen from some local atmospheric cause. A somewhat ruddy tint of the dark belts has often been observed; but it is by no means an invariable feature. Nor did I perceive anything like the "pale false shadow" mentioned by Mr. Dawson as preceding the third and first satellites in the form of an attached crescent. On referring again to Mr. Bird's account of his observation, I fail to find any reference to such an appearance as Mr. Dawson deduces from it—namely, that "the two extra dark spots *were not* the satellites, but that they were *beside* and *touched* the true satellites." Indeed, Mr. Bird distinctly says that, "with the exception of the centre one of the three [the third satellite], they were black as ink." He afterwards speaks of the "*pale satellites* closely following two of the black shadows;" but says nothing of any false or pale shadows. I intended carefully to scrutinise the transits both of satellites and shadows which have occurred since, but the weather has totally prevented any such observations.

In Mr. Darby's letter, on page 222, while acknowledging that he might have mistaken Sir W. Herschel's description of the relative position of the smaller star of μ^2 *Boötis*, he excuses his mistake by the "very ambiguous language of Sir William, which might possibly have been used in a sense different from that in which he understood it." I confess that I should be surprised to hear that any one who was competent to speak upon the subject at all, agreed with Mr. Darby in his judgment of Sir William's language. Mr. Darby asserts the "natural meaning to be, that the small star followed on the same line that joined the other two stars, and that *all three stars* were in a line in 1781." (!) But he has now made the discovery that "Sir William used the words *follow* and *precede*, *not* in their usual signification; and he meant by the expression, *changing sides*, not performing half a revolution, but *changing quadrants*, or crossing over the imaginary line which joined μ^2 to μ^1." Hence it is evident that Mr. Darby thinks that "passing over that imaginary line," and "changing quadrants," express the same thing! On the contrary, the small star *actually did* "pass over that imaginary line," but really *did not* "change quadrants." This, I am afraid, will appear to Mr. Darby to be a complete paradox!

I remain, Sir, yours faithfully,

Hopefield Observatory, Haddenham, Bucks: W. R. DAWES.
October 14, 1867.

Sir,—In the *Register* for last month, the Rev. W. R. Dawes notices, at some length, a misapprehension of mine of the precise meaning of the language of Sir William Herschel, in observations on the star μ Boötis, 1781–1802, as quoted in my letter of the *Register* for September. As my letter in explanation appeared following Mr. Dawes' critique in your last number, I need not again refer to the matter.

In my letter on μ Boötis there occurred the following sentence: "μ^2 Boötis is in my estimation a closer star than γ^2 Andromedæ, arising, as I think, from the following circumstances." On receipt of the *Register*, I turned to my manuscript copy, and found it: "μ^2 Boötis is in my estimation an *easier* star than γ^2 Andromedæ, arising, as I think, from the following circumstances." The error was that of the copyist, but it was so obvious that I did not think it worth the trouble of correction; the sentence as it stood was absurd in itself, and the circumstances referred to are sufficient evidence that "*easier,*" not "*closer,*" should have been the reading. Those circumstances were the colour and the distance of the great star (more favourable for separation in μ^2 Boötis than in γ^2 Andromedæ), the components of μ^2 Boötis nearly equal, and nearly on a line to the principal star. I may observe in reference to diminishing aperture caps and perforated discs, I have no idea of comparing the performance of my telescope (9-inch aperture refractor, 100 inches focal length, by Slater) with Alvan Clark's 8¼-inch refractor, of whose performance Mr. Dawes and others have spoken so highly. I find that my instrument bears very well, on fine nights, powers of 800, 1120, 1250; yet I cannot effect anything in the separation of close double stars with the diminished apertures or perforated discs which I cannot accomplish without such contrivances, and with full aperture; whatsoever I gain in definition by the former I lose in the distance of the separation of the component stars, and as to the latter, they are, I think, of some service where the stars are large and nearly equal, but are of positive injury where the stars are very unequal or where one star is very minute. I confess myself an unbeliever in the correctness of one remark made by Mr. Dawes, on the performance of object glasses: "the severest test of figure is the similarity of the image of a bright star when the focus is a little too long, and to an equal extent too short."—*Monthly Notices*, p. 236. I have observed with several refractors from 4 inches up to 9¼, some of them of very excellent definition, yet I have never found this "similarity of image;" the short focus resembles a spider's web, the concentric rings and interlacings fine and delicate, and all of a uniform light yellow colour, with the disc of the star at the centre. The long focus has the same number of rings, but much coarser, and the centre is purple and presents no star-disc whatever.

The great interest recently taken by amateur observers, who possess good telescopes, in the very difficult stars γ Andromedæ and μ Boötis, induced me to send to the *Register* two diagram eye-sketches of those stars, as they appear in the field of the telescope. I never supposed that any professional astronomer would think of subjecting my mere eye-sketches to the rigid scrutiny of a scale, which they were never designed to bear. Mr. Dawes acknowledges the tendency, both in himself and in others, to depict the distances of stars much too small in proportion to the diameters of their components, and adds on the same subject at the close of his letter, "But how few in making an eye-sketch would give it the true proportion, even if it were aimed at." My diagram of γ Andromedæ, which appeared in the *Register*, of August, I admit has no pretension to accuracy of proportions. I engraved a much more correct one, but omitted to send it.

Mr. Dawes observes of my diagram of μ Boötis, "the eye-sketch of μ^1

and μ^2 Boötis, which is attached to Mr. Darby's letter in this month's *Register*, is a remarkable instance of the neglect of the true proportions in such sketches. The central distance of B C is about 0″·55, the distance of A is 108″ or 196 times the central distance of B C."

The disc of my diagram represents the field of the telescope with a high power, about 27s. in time or 405″ in space. B is placed pretty correctly at about 108″ from A. On so small a scale, the whole field being less than 10″ of the scale of Mr. Dawes' diagram, it is utterly impossible to show the relative distances of B C; so small a space as that 0″·55 being invisible on my diagram, consequently violence must be done to the true proportions of distance in representing the discs and the distances of the small stars. If Mr. Dawes' section of the centre of the field were produced to 400″ in space as representing the full field, it would require a diagram of 3 feet 4 inches in diameter! As this would be impracticable, as a mode of intercommunication between observers, we must rest satisfied with either Mr. Dawes' section, which fails to be recognised by the eye, or my full field eye-sketch, with the disadvantage necessarily attached to the representation of distances under 1″.

I now come to Mr. Dawes' own diagrams in the March *Register*, and on examination I find that, though "drawn to scale," and professing "accuracy of proportions," they are by no means faultless. The star-discs are not in correct proportion to each other. γ Andromedæ and δ Cygni are of the same magnitude (3½), yet the diameter of the disc given of the former is 1/32 greater than that of the latter, and the disc of γ^2 Andromedæ is considerably less than that of the *comes* of δ Cygni, although the former star is 5½ magnitude, and the latter only 9. Moreover, the disc of γ^1 Andromedæ is made 6 times that of γ^2, although the former is 3½ magnitude and the latter 5½. Still further, as to the relative distances of the several stars, if the *comes* of δ Cygni is placed at the proper distance 1″·70, then it follows, according to the same scale, that γ^2 Andromedæ is erroneously placed out of proper distance, being 7″·30 distant from γ^1 instead of 10″·30. Mr. Dawes' correction in the April *Register*, shows that he had re-examined his diagram a month later, and had deliberately endorsed all except the comparative sizes of the discs of the components of γ Andromedæ. Finally, as to the angles of position. If the stars γ^1 and γ^2 Andromedæ, and also δ Cygni, be made the centres of circles drawn in pencil lines on the page (p. 51 *Register*, March), it will be readily seen, by actual measurement, that γ^2 is placed at the angle of position of 67° instead of 63°, and that γ^3 in relation to γ^2, is placed at the angle 122° instead of 106°, and that the *comes* to δ Cygni only is placed in its correct position of 348°.

I think it is sufficiently apparent from this examination of those diagrams, as well as from a former examination of his work as Editor of the small Star-Maps of the Society for the Diffusion of Useful Knowledge (see *Register* No. 35, Appendix), that even Mr. Dawes himself has sometimes been found a worshipper in the temple of *Somnus*, "nodding," perhaps not quite so profoundly, as well as some of his fellow-sinners of the class of amateur star-gazers; differing from them, however, in the peculiarity of his worship, intermingling his penitential *peccavi* with an occasional *Io Io triumphe*! something in the style of Napier, the conqueror of Scinde, who is *reported* to have expressed his confession of error in disobedience of orders in the same laconic despatch that announced his conquest—"*Peccavi*," "*I have sinned.*" (Scinde.)

Very truly yours,
W. A. DARBY.

Chorlton Hall, Manchester:
October 15, 1857.

THE LUNAR CRATER LINNÉ.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—There is a little ambiguity in the expression at the bottom of p. 172, for finding the value of seconds of arc in English feet at Linné, as well as one or two clerical errors, which may lead to some misapprehension. The expression would, I think, stand better thus—S representing seconds:—

$$S \times 6116\cdot7 \times \text{Secant } \overset{\circ}{29}\ \overset{\prime}{54}\ \overset{\prime\prime}{40} \text{ or}$$
$$7056\cdot6 = \text{Secant } 29\ 54\ 40 \times 6116\cdot7.$$

7056·6 feet being the value of a second at an angular distance of 29° 54′ 40″ from the moon's apparent centre. In the expression on the third line of p. 173, 7056 is the multiplier of the seconds as measured, and cos. α the division of the value at the moon's centre for the angular distance α. An example will probably suffice.

The measure of the little crater, on July 9, by Mr. Huggins, see *Monthly Notices*, vol. xxvii. p. 297, is 1″·71. Now S = 1″·71 therefore—

$$\left.\begin{array}{lr}\text{Log.} & \overset{\prime\prime}{1\cdot71} = 0\cdot232996 \\ ,, & 6116\cdot5 = 3\cdot786516\end{array}\right\} \qquad 4\cdot019512$$
$$\begin{array}{lrll} ,, & \text{Sec. } \alpha = \underline{10\cdot062081} & \text{Cos. } \alpha. & \underline{9\cdot937919} \\ ,, & 12067 = 4\cdot081593 & & 4\cdot081593\end{array}$$

$$\begin{array}{lr} \text{Log.} & \overset{\prime\prime}{1\cdot71} = 0\cdot232996 \\ ,, & 7056\cdot6 = \underline{3\cdot848597} \\ ,, & 12067 = 4\cdot081593 \end{array} \qquad \begin{array}{lr} \text{Log.} & \overset{\prime\prime}{1\cdot71} = 0\cdot232996 \\ ,, & \text{Cos. } \alpha = \underline{9\cdot937919} \\ & 0\cdot295077 \\ ,, & 6116\cdot7 = \underline{3\cdot786516} \\ ,, & 12067 = 4\cdot081593 \end{array}$$

1867·518 diameter of small crater 1″·71 12067 Eng. feet.—Huggins.

From a comparison of the measures of Mr. Huggins, on July 9, with mine made on the same evening, and also with a drawing of Linné, including the little crater, also on the same evening, by Mr. F. Bird of Birmingham, there can be no question that the measures of Mr. Huggins deserve the highest confidence, and I apprehend we have now—that so many good observers are directing their attention to Linné—for the first time in the history of this interesting spot, a *well-determined starting point* with which to compare all past and future observations; and although at present, from the paucity and vagueness of earlier observations, and the want of continuity of measures, since Herr Schmidt announced a change, considerable doubt hangs over the question as to whether Linné has undergone a comparatively recent change or not—yet some progress has been made. We certainly know more about the present appearance of the white spot and its small crater than we did at the close of the last year. If some lunar observer, possessed of good optical means and every appliance for examining the spot, will take Linné under his especial care, and measure, at least once in every lunation, these three elements as suggested to me by Mr. Huggins—viz., the diameter of the white spot, the diameter of the small crater, and its distance from the edges of the white spot—a careful discussion of such measures, if they extend over a considerable interval, could not fail of furnishing results bearing intimately on the questions now mooted. Such a course is in accordance with the suggestion of M. de Beaumont, that observations should be multiplied, for a single alteration, however slight, if it were well established, would suffice to show that geological life exists in the interior of the moon as well as in the interior of the earth.

In the communication of Mr. Huggins to the Royal Astronomical Society the following passage occurs—*Monthly Notices*, vol. xxvii. p. 296:—"The character of the surface of the white spot may be described as similar in appearance to that of a cloud, for it presented no distinct details, and remained undefined when the small neighbouring craters were seen with great clearness." This character, I believe, has been extensively observed, and is an important fact in the history of Linné. Mr. Huggins goes on to say: "The absence of any defined points upon which the eye can rest is probably the reason that the 'boiling' motion of our atmosphere is perceived in a much more marked manner over the white spot than on the adjoining sharply-defined parts of the moon's surface." It may be well to note, in connection with the following sentence, that no fact is communicated in the preceding sentence. Mr. Huggins proceeds: "From this cause Linné appeared, on several occasions, *as a mass of white cloud in motion*, at the same time that the craters near it were seen steadily and with distinctness." I have italicised a portion of the sentence as indicating another important fact. The quotation from Mr. Huggins concludes thus: "This cloudy appearance arises probably from a peculiar, partly reflective property of the material of which Linné consists. Some other portions of the moon's surface reflect light in an analogous manner."

Respighi, in his communication (*Bulletin Météorologique de l'Observatoire du Collége Romain*, 31 mai 1867), mentions the following fact: "En comparant le petit cratère avec les cratères voisins, on a remarqué que dans les moments où l'atmosphère était agitée, le premier devenait facilement confus et disparaissait, tandis que les autres restaient suffisamment distincts." These observations of Respighi and Huggins indicate the importance of carefully recording appearances of this kind as well as measures. A great portion of lunar study consists in noticing the aspects of objects; and although lunar objects undergo sensible changes of aspect, some of which can be well accounted for, there are others which are very puzzling to the observer, such as those alluded to above. In my own experience I find it very difficult to conceive that the "boiling" motion of our atmosphere, or an appearance analogous to it, *but dependent upon it*, should be restricted to a spot of about 50,000 English feet in diameter (7″·0), while the craters near are seen steadily and with distinctness. In the course of my own observations I have generally found that the slightest agitation of our atmosphere is first noticed by the small craters (points upon which the eye can rest) becoming wavy, sometimes doubled, and generally indistinct. I do not recollect an instance, *i.e.*, of the wavy and indistinct appearance of craters arising from the agitation of our own atmosphere being confined to any portion of the moon's disc.

There is a curious difference between the phenomena recorded by Mr. Huggins and by Respighi. It is important to note they were not observed on the same evening. Mr. Huggins attributes the appearance of Linné "*as of a mass of white cloud in motion*, to the absence of any defined points upon which the eye can rest," and which "is probably the reason that the 'boiling' motion of our atmosphere is perceived in a much more marked manner over the white spot." Respighi speaks of the little crater becoming easily confused and disappearing, while the neighbouring craters remained sufficiently distinct; but he does not adduce a reason for this phenomenon. The history of science is full of instances of residual phenomena, and it is possible that this indistinctness, or apparent motion, confined to the white spot of Linné (a phenomenon, by the way, which I have frequently noticed on other parts of the moon, so far as indistinctness is concerned, especially under high illuminations), may be of that nature, and needs very careful watching, in order to determine its real character. The observers just quoted are not alone in the record of the *fact* that Linné, at the epoch of the *first half* of 1867, presented the appearance mentioned above, and it is a *fact* that ought not to escape attention, whether it can or cannot be explained by alterations in our own atmosphere. Standing alone it may be difficult of explanation, but combined with other facts which observation may bring to light, it may be found of important significance.

It is not improbable that other objects on the moon's surface may become of equal interest with Linné, for there are many obscure points yet to clear up, and it is only by repeated observation and measurement that progress can be made. A general expression for finding the extent of an object in English feet may therefore be acceptable.

Let E = the extent of an object in English feet.
,, α = the angular distance of the object from the moon's centre.
,, S = the number of seconds contained in the measurement of the object.
,, F = the value of a second in English feet at the moon's centre.
,, F' = the value of a second in English feet at α.

Then $F' = F \times \text{Sec. } \alpha$, or $\dfrac{F}{\text{Cos. } \alpha}$ and

,, $E = S \times F \times \text{Sec. } \alpha$, or $\dfrac{S \times F}{\text{Cos. } \alpha}$, or $S \times \dfrac{F}{\text{Cos. } \alpha}$, or $S \times F'$.

Examples.—On July 9, 1867, I measured the white cloud at a position angle of 0°, and found it $7''\cdot0041$. We have accordingly $\alpha = 29^\circ\ 54'\ 40''$. $S = 7''\cdot0041$ log. $0\cdot845352$ $F = 6116\cdot7$ log. 3.786516. Therefore for F' we have:—

$$6116\cdot7 \times \text{Sec. } \overset{\circ}{29}\ \overset{\prime}{54}\ \overset{\prime\prime}{40} \text{ or } \frac{6116\cdot7}{\text{Cos. } 29\ 54\ 40} = 7056\cdot6$$

$$\begin{array}{rl}
\text{Log. } 6116\cdot7 = & 3\cdot786516 \\
\text{,, Sec. } \alpha = & \underline{10\cdot062081} \\
\text{,, } 7056\cdot6 = & 3\cdot848567
\end{array}$$

and for E we have $7''\cdot004 \times 6116\cdot7 \times \text{sec. } \alpha$ or

$$\frac{7''\cdot004 \times 6116\cdot7}{\text{Cos. } \alpha}, \text{ or } 7''\cdot004 \times \frac{6116\cdot7}{\text{Cos. } \alpha}, \text{ or } 7''\cdot004 \times 7056\cdot6$$

$$\left.\begin{array}{rl}
\text{Log. } \overset{\prime\prime}{7}\cdot004 = & 0\cdot845352 \\
\text{,, } 6116\cdot7 = & 3\cdot786516
\end{array}\right\} \qquad 4\cdot631868$$

$$\begin{array}{rlll}
\text{,, Sec. } \alpha = & \underline{10\cdot062081} & \text{Cos. } \alpha & \underline{9\cdot937919} \\
\text{,, } 49425 = & 4\cdot693949 & & 4\cdot693949
\end{array}$$

$$\begin{array}{rl}
\text{Log. } \overset{\prime\prime}{7}\cdot004 = & 0\cdot845352 \\
\text{,, } 7056\cdot6 = & \underline{3\cdot848597} \\
 & 4\cdot693949
\end{array}$$

The mean of the two measures, length and breadth, by Mr. Huggins, as furnished to me, is $6''\cdot996$, which differs from the above measures by $0''\cdot008$. The value of E for the white spot may therefore be regarded as well determined for the epoch 1867·518—viz., $7''\cdot00$, or 49,425 English feet, which is a larger diameter assigned to Linné in 1831 by either Schmidt or Beer and Mädler. This diameter exceeds the earliest of Schmidt's by nearly 13,000 feet, or more than 2½ miles.

If Schröter's description of the spot *v*, in 1788, quoted by Mr. Huggins, really represents—as it seems to do—the present appearance of Linné, and there should have been no alteration within the intervening 79 years, the records of Lohrmann, Beer and Mädler, and Schmidt, between 1822 and 1842, are erroneous in three important particulars—viz., character, size, and brightness. With regard to size, the measures on July 9, 1867, are conclusive as to the extent of Linné at that epoch, when the moon was more than three degrees north of the ecliptic, and Linné was removed further from the eye than in mean libration, the foreshortening being greater in the radial direction. If, therefore, Schmidt's estimate is to be referred to mean libration, Linné ought to have been seen under a *larger* angle when he made the estimate, and not a *smaller*, as compared with the measure of breadth by Mr. Huggins; this at once indicates the large amount of error attaching to the determinations of Schmidt and Beer and Mädler.

The superior brightness assigned to Linné by Lohrmann is perfectly intelligible in connection with his statement of its being a very deep crater, but, as Mr. Huggins remarks, is not in accordance with its present appearance. A superior brightness would result from the interior walls of a crater strongly reflecting the sun's rays, and it is remarkable that generally the deepest craters are the brightest; the error of Lohrmann in this respect appears to amount to as much as 1°·5, if not to much more.

Whether the three authorities above named are in error or not, one consideration appears to force itself on the mind—viz., that selenographical science has not attained that degree of *precision* which characterises other branches of astronomy, and without which it is very difficult to dispose of questions such as are now agitated with regard to Linné. It is quite clear that previous observations are not sufficiently precise to enable us to determine the actual state of Linné, without the possibility of question, earlier than July 9, 1867; but on this day the records appear to be sufficiently exact to prevent a question being raised as to what was really seen on the space occupied by Linné on the moon's surface. There is only one point of uncertainty—viz., the distance of the little crater from the measured edge of the white spot which Mr. Huggins describes as not ending abruptly, but passing gradually into the darker surface of the *Mare Serenitatis*.

In *Les Mondes*, of August 1, 1867, a short note is inserted of a communication to Herr Haidenger, by Herr Schmidt, having reference to an observation of Linné by Schmidt on May 10, 1867, the day on which Respighi estimated the diameter of the small crater at 4″·0. Schmidt's estimate on the same day is 500 toises, or 3197 English feet = 0″·45, at mean libration, about ⅑ of Respighi's estimate. Schmidt's is very much more in accordance with the preceding and succeeding estimates of the size of the small crater than Respighi's.

Apologising for the length to which this letter has extended,

I remain, Sir, your obedient servant,

42 Sewardstone Road West, Victoria Park, W. R. BIRT.
London: August 10, 1867.

Errata—p. 172, line 15, and last two lines, for 29° 55′ 50″ read 29° 54′ 40″ On line 25, for 1867·636 read 1867·036; p. 173, line 2, for 3·848561 read 3·848597; for log. cos. 29° 55′ 50″ = 9·937955 read log. cos. 29° 54′ 40″ = 9·937919.

LUNAR ECLIPSE.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I wish to call attention to an observation made by me during the late lunar eclipse respecting the visibility of Aristarchus.

As the earth's shadow progressed, Aristarchus continued to be well seen till nearly the greatest phase, just before which I saw it as an 8th magnitude star, but after that I did not see it at all.

This observation being at variance with that of Mr. Birt, made during the total eclipse of 1863, I should be glad to know if any other observers, during the night in question, took note of the appearance of the region, as it may have been smallness of aperture (4½ in.) or local influences that caused it to disappear in my instrument.

I am, Sir, yours truly,
HERBERT INGALL.
366 Albany Road, Camberwell:
October 14, 1867.

ASTRONOMICAL SUBJECTS FOR AMENDMENT.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—We look forward with some anxiety to the approaching meetings of the R. A. S. May we hope that the elements of discomfort (if not of discord) and of dissatisfaction, which appeared so frequently during the last session, will disappear in the coming one? Science is of no party. We feel this to be the case in the great subjects of thought on which men differ and contend with each other. We have seen at our meetings orthodox Evangelical Churchmen sitting beside Bishop Colenso: and as to politics, our Whigs and Tories leave these outside with their hats and coats when they come to our meetings. During the late civil war in America, we have seen fierce Southerns on the same bench with Mr. Adams, the accredited minister of the Northern States, listening in perfect harmony to our proceedings. Well, then, since we manage to be so far true to our principles as a scientific body, should we allow minor considerations and every petty feeling of *temper* to interfere with the welfare of the noblest of our scientific societies? Yet such has been the case. Some of our members were certainly unkindly received when they stood up to speak or read papers, and in connection with this there were considerable displays of temper on both sides. In some instances, it must be acknowledged, the display was of *good* temper. In future, this should be the rule, and not the exception.

There was a very unseemly exhibition on another particular, which should never be repeated. Some member had not paid his subscription. The time and the attention of the meeting were occupied with considering how this defaulter should be hunted and persecuted, and a man of science spoke like a cunning attorney, and seemed to be ready to act the part of a bailiff if necessary. It was also proposed or threatened to give the delinquent "immortality" by putting his name in the "Monthly Notices." Well, Mr. Editor, had this been done, many are of opinion that others besides the delinquent would have gained an "immortality," and of the same kind. I would mention another circumstance. We are fortunate in having a president who is an eminent scholar, and of varied and accurate knowledge touching astronomical topics. He is also a ready and clear speaker, and he does not require to be urged on in this particular, as many men of learning do. There is more of redundancy than of deficiency in our chairman's remarks. But we may venture to hint that he need not catechise such men as J. C. A. as if they were school-boys, when they stand up to deliver their intended statements. These questions tend to show the acumen of the chairman, but in general spoil the address of the speaker. I shall go no further with my list of grievances at our meetings, but, Mr. Editor, I desire to find fault (as I am in a fault-finding mood) with yourself also. I think you are to blame for publishing ill-tempered letters. They are unworthy a place in a scientific periodical. Again, it is unkind of you to publish silly questions and inquiries. May I add, that I did not like the spirit of the F.R.A.S. who thought he did not get value for his two guineas? Pray tell him, that if he put his subscription in one scale and his share of a speech of Professor Adams, or of the Astronomer-Royal, in the other, he may find out how unreasonable is his complaint.

And now, Mr. Editor, believe me that I send you the above because of my great admiration of the R. A. S., and of the high value I set on your interesting and useful publication.

Faithfully yours,
October 18, 1867. PETER PINDAR, A.R.

REVIEWS.

In an excellent Sermon preached by the Rev. Charles Pritchard, President of the Royal Astronomical Society, on the occasion of the Meeting of the British Association at Dundee, the *Analogy of Intellectual Progress to Religious growth* is pointed out. He shows that the main principles implanted in man for the maintenance and discharge of his social relations are of a like kind with those which in the Holy Scriptures are declared necessary to save him from the consequences and the power of sin, and restore him to the favour and the image of God. The laws after which we see God has fashioned man's nature, as to his social and temporal life, are in harmony with those by the operation of which Revelation declares it is God's good pleasure to fit his now sinful children for their sinless, eternal inheritance in the society of the redeemed. The education of the religious principle, as proposed and provided for in the Bible, agrees with what we are taught by experience regarding the education of the intellectual faculties. Physical knowledge has made many men useful and great: it is the power of God, as revealed in the Gospel of His Son, which alone can make all of us happy and good. After giving a number of examples of the happy combination of intellectual strength with the Christian spirit, Mr. Pritchard concludes with a touching reference to the loss sustained by the death of Michael Faraday, not only in a scientific point of view, but also as that of a man who carried a spirit of Christian gentleness and tenderness into all his work.

Mr. W. E. Hickson is republishing in a convenient form some of the notes he has been in the habit of making through many years on a variety of subjects. He expects to issue about twelve numbers in each year, at a price of sixpence each. The remarks of a man who has for a long period been so much engaged in reviewing matters of a social, administrative, scientific, musical, and historical nature as Mr. Hickson, will well repay perusal; and we can recommend them to our readers as well worth the trifling expense. They are published by Groombridge, under the title of "Tracts for Enquirers."

The Riverside Magazine, a popular periodical, published in New York, contains in its eighth number an excellent plan of the "Stars for August," with a description of the appearance presented by the heavens in language divested of technicalities.

Results of Astronomical Observations made at the Melbourne Observatory in the Years 1863-4-5. This volume, just to hand, records the work performed under the direction of Mr. Ellery, and contains a description of the principal instruments employed. These are, a 4-foot Transit circle, with collimators, by *Troughton and Simms*; a 42-inch Transit, by the same; an 8-foot prime Vertical, by *Ertel and Sons*; a 5-foot Equatorial, by *Troughton*; three clocks, by *Frodsham*, and several other instruments. The volume also contains a description of the Observatory, which is a handsome structure of stuccoed brick; the principal rooms are on one floor, with the equatorial room above. It is situated in an enclosure of four acres, sufficiently far from the city to be free from smoke, dust, and vibration. The observatory was completed in 1863, upon the dismantling of that at Williamstown, the instruments from which were removed to the new building.

The LEVANT HERALD, of the 28th of August, contains an account of the *Disappearance of Jupiter's Satellites* on the 21st of that month, observed by the Rev. C. B. Gribble.

NORTON.—A Treatise on Astronomy, Spherical and Physical; with Astronomical Problems, and Solar, Lunar, and other Astronomical Tables. By William A. Norton, M.A., Yale College. 4th edition, revised. 8vo. cloth, pp. xiv., 443 and 115. 15 plates. New York, 1867. 15s. Trübner & Co., Paternoster Row.—Will some one give the leading features of this work?

THE PLANETS FOR NOVEMBER.

Mercury may be seen as an evening star at the beginning of this month, being visible for nearly three-quarters of an hour on the 1st. After the 22nd he may be seen in the morning, and at the end of November will be visible for an hour and a-half before sunrise.

		h.	m.	s.		°	′		
1st	R.A.	15	57	21	Decl. −	23	21½	Diameter	6″·8
15th	,,	16	17	47	,,	22	47½	,,	9″·6

Venus may be seen for a short time in the evening, at the beginning of November, setting about twenty minutes after the Sun. At the end of the month she may be observed for an hour in the evening.

1st	R.A.	15	3	7	Decl. −	16	54	Diameter	10″·0
15th	,,	16	14	51	,,	21	28	,,	10″·0

Illuminated portion of the disc of Venus, 0·976.

Jupiter is still conspicuous in the evening, setting about midnight at the beginning of November, and about half-past 10 on the last day of the month.

1st	R.A.	22	1	37	Decl. −	13	24½	Diameter	43″·4
15th	,,	22	4	17	,,	13	7½	,,	41″·4

Neptune is still well situated for observation, passing the meridian about 10 o'clock on the 1st, and about two hours earlier at the end of the month.

5th	R.A.	0	50	2	Decl. +	3	35
17th	,,	0	49	5	,,	3	29½

ASTRONOMICAL OCCURRENCES FOR NOV. 1867.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon
Fri	1		Sidereal Time at Mean Noon, 14 41 13·1 Meridian passage of the Sun, 16m. 17s. before Mean Noon	1st Ec. R.	4 42 25	— 3 46·9
Sat	2	4 49	Near approach of Moon to B.A.C. 6658 (6)	2nd Sh. I. „ Tr E. „ Sh. E.	6 9 6 28 9 0	4 34·2
Sun	3					5 21·0
Mon	4	2 27	☽ Moon's First Quarter	3rd Oc. D. 4th Oc. R.	8 35 9 3	6 7·1
Tues	5	12 31	Conjunction of Moon and Jupiter, 2° 35′ S.	1st Tr. I.	11 14	6 52·8
Wed	6	10 29 11 38 11 56 12 47	Occultation of λ Aquarii (4) Reappearance of ditto Occultation of 78 Aquarii (6) Reappearance of ditto	1st Oc. D.	8 33	7 38·4
Thur	7	1 22	Conjunction of Saturn and Venus, 1° 49′ S.	1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E. 2nd Oc. D	5 42 7 1 8 2 9 20 11 2	8 24·5
Fri	8	7 6 8 21	Occultation of 10 Ceti (6) Reappearance of ditto	1st Ec. R. 3rd Sh. E.	6 38 9 7 36	9 11·7
Sat	9			2nd Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	6 8 8 48 9 2 11 38	10 0·7
Sun	10	8 27	Near approach of Moon to ξ^1 Ceti (4½)			10 52·1
Mon	11	13 9	○ Full Moon	2nd Ec. R.	5 46 45	11 46·3
Tues	12	11 15 12 0 13 25 14 13 17 39 18 29 17 50 18 21 17 54 18 15 18 28 19 20 19 23	Occultation of 48 Tauri (6) Reappearance of ditto Occultation of γ Tauri (4) Reappearance of ditto Occultation of θ^1 Tauri (4½) Reappearance of ditto Occultation of θ^2 Tauri (4½) Reappearance of ditto Occultation of 75 Tauri (6) Reappearance of ditto Occultation of B.A.C. 1391 (5) Reappearance of ditto Near approach of Moon to 85 Tauri (6)			12 43·4
Wed	13	15 10 15 23 16 42	Occultation of 111 Tauri (6) Reappearance of ditto Near approach of Moon to 115 Tauri (5½)	4th Sh. E. 1st Oc. D.	8 0 10 28	13 42·9
Thur	14	11 45	Conjunction of Mars and Venus, 0° 18′ N.	1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	7 36 8 57 9 56 11 16	14 43·4

DATE		h. m.	Principal Occurrences	Jupiter's Satellites	h. m. s.	Meridian Passage h. m.
Fri	15	4 59 8 35 16 10	Conjunction of Moon and Uranus, 4° 41′ N. Conjunction of Venus and Mercury, 1° 6′ S. Conjunction of Mars and Mercury, 0° 44′ S.	**1st** Oc. D. **3rd** Tr. E. „ Sh. I. **1st** Ec. R.	4 56 6 15 8 3 8 33 52	Moon — 15 43·4
Sat	16		Sidereal Time at Mean Noon, 15 40 21·4 Meridian passage of the Sun, 15m. 8s. before Mean Noon	**1st** Tr. E. „ Sh. E. **2nd** Tr. I.	4 24 5 45 8 44	Jupiter — 6 23·2
Sun	17					6 19·6
Mon	18	5 6 16 21 16 42 23 42	☾ Moon's Last Quarter Occultation of 44 Leonis(6) Reappearance of ditto Conjunction of Saturn with the Sun	**2nd** Ec. R.	8 23 32	6 16·0
Tues	19					6 12·4
Wed	20					6 8·8
Thur	21	13 19 16 21 16 54	Inferior Conjunction of Mercury Occultation of *k* Virginis(6) Reappearance of ditto	**1st** Tr. I. „ Sh. I.	9 31 10 52	6 5·2
Fri	22			**3rd** Tr. I. **1st** Oc. D. **3rd** Tr. E. **1st** Ec. R.	6 36 6 52 10 15 10 29 34	6 1·6
Sat	23			**1st** Sh. I. „ Tr. E. „ Sh. E.	5 21 6 20 7 40	5 58·0
Sun	24	23 9	Conjunction of Moon and Mercury, 3° 10′ S.	**1st** Ec. R.	4 58 32	5 54·5
Mon	25	4 3 17 11	Conjunction of Moon and Saturn, 3° 4′ S. ● New Moon	**2nd** Oc. D.	5 31	5 50·9
Tues	26	12 10	Conjunction of Moon and Mars, 5° 37′ S.	**3rd** Ec. R.	5 27 21	5 47·4
Wed	27	2 25	Conjunction of Moon and Venus, 5° 37′ S.	**2nd** Sh. E.	6 13	5 43·9
Thur	28					5 40·4
Fri	29			**1st** Oc. D. **4th** Tr. I.	8 48 9 16	5 36·9
Sat	30			**1st** Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	5 57 7 17 8 16 9 36	5 33·4

BRIEF CORRESPONDENCE.

DENSITIES OF THE ASTEROIDS.—The masses of celestial bodies cannot be found unless they retain a satellite in a known orbit, or exert a measurable perturbing influence on other bodies. There is little reason to hope, then, that we shall ever know the densities of the majority of the asteroids. G. L. T.

THE BEDFORD CATALOGUE.—The objects in this Catalogue are under re-observation by Mr. Fletcher, who has promised us another edition, but not immediately. G. L. T.

VULCAN.—" A Subscriber " is not aware that the existence of Vulcan is not believed in by the great majority of astronomers. G. L. T.

THE MINOR PLANETS.—Could the diameters of the minor planets assigned by Mr. Stone (see *Register* for August, p. 190) be given in the *Astronomical Register?* G. J. W.

BINARY STARS.—Would some of the subscribers who have previously furnished binary star measures, kindly give the most recent measures of the principal and most interesting ones, including μ^2 Boötis, the orbit of which seems to be very interesting? S. B.

THE MOON.—In answer to "Ignoramus," as the sun turns round to the earth once in about 27d. 5h., it turns round to the moon also in about 27d. 5h., on the average; for as the moon is always very near the earth in comparison with their distance from the sun, almost exactly the same side of the sun must be facing the moon and the earth. There is no connection between this and the rotation of the moon. T. W. B.

LARGE OBJECT-GLASSES.—Can anyone say what is being done with the large object-glass which Cooke and Sons are making to be erected in Egypt? It was, I believe, commenced in 1864, or earlier, and we have yet no news as to when it is to be completed. It cannot surely take *four years* to grind and test the glass—and the stand is a mere matter of engineering which, in the present day, presents but little difficulty. It is whispered in many quarters that the undertaking is somewhat beyond the powers of the opticians engaged. Is much done with Mr. Buckingham's 20-inch? C.

TRANSIT OF VENUS.—Can you inform me where Sabrina Land, the place fixed on for observing the next Transit of Venus, is? I have looked through all the maps and gazetteers I have been able to see, and can find no mention of it anywhere. Longmans' expensive Topographical Dictionary does not notice it. D. T. K.

LOCKYER'S POPULAR ASTRONOMY.—Mr. Lockyer is preparing an Introduction to our science for the use of beginners. When is it likely to be published? BARRINGTON.

CARL'S "REPERTORY OF COMETS."—Can any reader of the *Ast. Reg.* oblige me with a sketch of the plan and character of this book, which seems well known in Germany? If I could learn it were worth having, I would buy a copy. G. F. C.

SIR JAMES SOUTH.

This distinguished astronomer died last month at a great age—upwards of eighty years. He was one of the founders of the Royal Astronomical Society, and took great interest in its early proceedings, being President for some time. Sir James South worked with great energy at the science of astronomy, and compiled a valuable catalogue of double stars, in conjunction with Sir John Herschel, which is a standard of reference up to the present time; a full description of the instruments used is to be found in the *Philosophical Transactions* for 1825. Increasing age and infirmity have caused his name to be little mentioned in connection with astronomy of late years, but he took the greatest interest in the science, and his observatory at Campden Hill is still furnished with a great number of large and valuable instruments.

We regret to announce also the death of Lord Wrottesley, who was in like manner one of the founders of the Astronomical Society, the gold medal of which he received for his *Catalogue of Stars* in 1839. He was President of the Royal Society from 1854 to 1857.

INSTRUMENTS, &c. FOR SALE.

These Notices, which are restricted to *two lines* each, are inserted free of charge to subscribers: applications respecting prices and other particulars to be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—For Advertisements with prices and more complete details, a small charge will be made.

N.B.—It is particularly requested that we may be informed when instruments are disposed of, in order that the notice may be withdrawn, and fruitless applications prevented.

Achromatic Refractor, 6·4 in. ap. 8½ ft. focus, by *Merz*, Equatorial and clockwork by *Troughton & Simms.* [73]

Achromatic Refractor, 4 in. aperture, by *Cooke & Sons*; equatorially mounted, complete in every respect. [104]

Achromatic Refractor, 3¼ in. ap. 50 in. focus, with brass tripod, comet, landscape, and 4 other powers 74 to 260. [111]

Gregorian Reflector, 4¾ in. ap. 2 ft. focus, by *Dollond*, 4 powers, 50 to 200, finder, &c., on brass table stand. [63]

Achromatic Object-Glass, 4⅛ in. ap. 62 in. focus, by *Slugg*, with brass cap and receiving cell, for mounting on tube. [85]

Transit Instrument, 3¾ in. ap. 5 ft. focus, Ys fitted with agates for mounting on stone piers. [29]

Transit Instrument, 2¾ in. ap. 30 in focus, by *Troughton & Simms*, with micrometer eye-piece and cast-iron adjustible stand. [107]

Equatorial Stand, for 5 ft. telescope: with circles, &c. complete. [99]

Equatorial Stand, for a 5 or 6 ft. telescope: 13 in. circles, divided on silver, to 10″ of space and 4s. of time.—Has never been used. [55]

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Right Ascension and Declination Circles, 10 in. [109]

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Astronomical Clock: zinc and steel compensation; price low. [114]

Recreative Science: and the first three volumes of the **Photographic Journal:** price very low. [30]

Lalande's Astronomy, 2 vols. 4to. [108]

INSTRUMENTS, &c. WANTED.

Astronomical Clock, not very first-class; price low. [65]
Equatorial Stand, for a 5 ft. Refractor: graduated circles. [35]
Garden Stand for 8 ft. Achromatic; price low. [112]
Brass Tripod for a 2 ft. Telescope: condition not material. [106]
Transit Instrument, 2 in. ap. 18 or 24 in. focus. [71]
Transit Instrument, 1½ in. aperture, about 20 in. focus. [102]
Monthly Notices of the Royal Astronomical Society, Vol. 3. [26]
Monthly Notices: Vol. 5, No. 12. [82]
Bartholomew Prescot on the Universe, published 1823: a copy wanted, in good condition. [84]
Galbraith's Mathematical and Astronomical Tables, 2nd edition. A good price will be given for a clean copy. [105]

In M. De Fontenelle's *Pluralité des Mondes* (1685) is a passage which shows that the structure of the rings of Saturn, elaborately illustrated in Mr. Proctor's valuable work, had been guessed at long ago. The passage is (Quatrième Soir)—"Si cependant l'anneau n'estoit, comme quelques-uns le soupçonnent, qu'un cercle de lunes qui se suivissent de fort près, et eussent un mouvement égal, et que les cinque petites lunes fussent cinq échapées de ce grand cercle, que de mondes dans le tourbillon de Saturne!"

LIST OF SUBSCRIBERS—Name received since our last number.

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ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To October 1867.
Turberville, H.

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Elliott, R.
Glover, E.
Linwood, Rev. W.
Wolley, Rev. J.

To March 1868.
Birmingham, J.
Burlingham, R.
Mills, E. B.

To December 1868.
Pritchard, Rev. C.

NOTICE TO CORRESPONDENTS.

The paper by *Professor C. P. Smyth* on the "Pyramids of Egypt" in our next.

ERRATA IN No. 57.

Page 198, near the centre, *for* Al-cy′-ō-ne, *read* Al-cy′-ŏ-ne.

And near the foot of the same page, *for* Ni′-ō-be, *read* Ni′-ŏ-be, as the accents would indicate.

Page 199, 15 lines from foot, *for* Kochal, *read* Kochab.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham House, Pembury Road, Clapton, N.E.,* **not later than the 15th of the month.**

ORIGIN

OF

THE SIGNS OF THE ZODIAC.

BEING EXTRACTS FROM

"MAZZAROTH, OR THE CONSTELLATIONS,"

BY THE LATE F. ROLLESTON.

WITH ADDITIONS AND REMARKS BY

GEORGE J. WALKER.

LONDON : 1867.

ORIGIN OF THE SIGNS OF THE ZODIAC.

THE object of this work is to show, by the combined testimony of tradition and of ancient writers, and from the meaning of the yet extant ancient names of stars and emblems, that they were invented to transmit the earliest and most important knowledge possessed by the first fathers of mankind. (Preface.) Great credit must be given to the pious and ingenious authoress, for the extensive reading and research which, embracing a period of more than half a century, only terminated with her decease a few years ago, whilst the concluding part of her work was passing through the press. It discusses a wide range of subjects, but not much more is here reproduced than portions relating to the zodiacal signs, omitting the etymologies of the names (in which Semitic roots are supposed to be found) as for the most part too uncertain to be of real use. Those, however, who are competent to judge, should consult the original work; whilst such as are not sufficiently versed in the languages in question, should take care not unconsciously to endorse the saying of Voltaire: "L'étymologie est une science où les voyelles ne font rien, et les consonnes fort peu de chose."

It is hoped that these extracts may interest many, who, with more or less knowledge of astronomy, value above all the inestimable Volume of Inspiration, and have attained by its teaching to the priceless knowledge of pardon and peace, by faith in the atoning sacrifice of the Son of God. Such will not the less enjoy their favourite and fascinating science if they should see reason to adopt the views of its symbolism here presented, and to number with the host of astronomical observers of other times, such names as Adam and Seth, Enoch and Abraham; whilst those to whom these views may perhaps appear fanciful, will perceive that, at least, no harm is done by this attempt to supersede the mythology of the Greek sphere. For be it so, that no scriptural truths were linked with the constellations by those ancient fathers, or, at all events, that this cannot now be proved, those truths themselves will rest on the same immovable basis as ever, and, so far, it is of no consequence whether, for example, one sees in Aries a memorial of the adorable Lamb of God, or of the mythic golden fleece of the Argonauts.

As to the Greek astro-mythological system, the writer of the articles on the constellations in the "English Cyclopædia" says, (Orion) that it has "the appearance of being an application of existing fables to a subdivision of the stars derived from the East, mixed perhaps with the Oriental allegories, imperfectly understood. The trivial character of the myths by which the Great Bear and Orion, perhaps the two most remarkable constellations in the heavens are accompanied, is enough of itself to upset any claim to high antiquity for the system above noted."

Allusion is made in the following extracts to the famous zodiac of Dendera, of which there is a description accompanied by a large and accurate plate in "Mazzároth." Information respecting it is also found in the article "Zodiac," English Cyclopædia, with a smaller plate. The elaborate investigation of Biot made it probable that it represents the state of the heavens 716 B.C. The author of "Mazzároth," with Dupuis, assigns to it a much greater antiquity.* A small print of the Dendera Zodiac is also given in "Cassell's Dictionary of the Bible," art. "Constellations."

The figures of the 48 ancient constellations on our maps and globes are (or should be) according to the minute description of Ptolemy (A.D. 140), whose catalogue is thought to be, in the main, really that of Hipparchus (B.C. 150). See Professor De Morgan's "Companion to the Maps of the Stars," published by the S. D. U. K., and the valuable article "Ptolemæus" in "Dr. Smith's Dictionary of Greek and Latin Biography," &c.

מַזָרוֹת Mazzároth (Job 38-32) or, as it is written, 2 Kings 23.5. מַזָלוֹת Mazzáloth, is understood by Aben Ezra of the stars generally, but by Gesenius of the signs of the zodiac, and this is probably its true meaning. He thinks the signification is "premonitions," and in the concrete sense, "stars that give warnings or presages.' Is it possible that this is an indication of the original intention of these signs, as *prophetic symbols*, afterwards misinterpreted, or perverted into astrological superstition?

The following works may be consulted for information about the literature of the constellations, their symbolism, &c.:—"Smyth's

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* "It may be presumed," says the writer of the article above-mentioned, "that the present sculptured zodiacs are copies of others which were the works of the earliest artists, so that, although they determine nothing respecting the time of the construction of the temples, they may still serve as indications of the manner in which the heavens were represented in the East in the infancy of astronomical science."

Cycle of Celestial Objects," vol. 1. pp. 435–452; and vol. 2 passim. "Smith's Dictionary of Greek and Roman Antiquities," Art. "Astronomia."—Dr. A. W. Schlegel, *De Zodiaci antiquitate et Origine*, Bonn, 1839. In Mr. Proctor's "Saturn and its System," is a long and interesting note on Chaldæan astronomy.

In what follows, inverted commas distinguish the extracts from "Mazzároth," and reference is made to its author, by her initials F. R.

"There are few who have not heard of the twelve signs of the zodiac; but what they are is not always distinctly understood. It is sometimes imagined that the forms of a ram, bull, or lion, may be traced among the stars: but none such can be recognised. Those stars said to belong to the ram might as well be supposed to belong to the bull or the lion. In almost every case the names have no affinity with the natural position of the stars: they are what the inventors of astronomy thought fit to annex. These signs were known among all nations and in all ages. From the almost antediluvian chronologies of China, India, and Egypt, to the traditions of the recently discovered islands of the South Sea, traces of them are discovered, most clearly among the most ancient and earliest civilised nations. In the remains of Assyria, they are recognised; in those of Egypt they are perfectly preserved; in those of Etruria and Mexico they are traceable. This wide diffusion indicates a common origin, both of the race of man and of the symbols of astronomy.* The love of symbols has been considered as natural to man; the creation amid which he is placed, as symbolical. Of this universal tendency the inventors of astronomy seem to have availed themselves, rendering it subservient to man's spiritual education, by familiarising to his mind the lofty truths of Divine revelation."

"The earliest positive evidence of the primeval existence of the signs is in the Chinese annals, where it is said that the Emperor Yao, 2,357 years before the Christian era, divided the twelve signs of the zodiac by the twenty-eight mansions of the moon; but it is not said that he invented them. The Chinese national emblem of the dragon appears to be the dragon of the sphere, which was at that time the polar constellation, the brightest star in the dragon's head [body] having been the pole-star in the antediluvian ages. [α Draconis was once rated of the second magnitude; upwards of 4,600 years ago, it was the pole-star of the Chaldæans, being then within 10′ of the polar point, a point which will not be approached by α Ursæ Minoris nearer than 26′.30″ (Cycle, vol. 2, p. 314)]."

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* "The distribution of all the visible stars into groups or constellations was the first step in laying the foundation of astronomical science. It must have taken place in the earliest ages of the world; and there is the highest degree of probability that the zodiacs of all nations have been derived from a common source, though in passing from one people to another it may be easily conceived that the figures would suffer changes from the vanity or caprice of individuals."—*Eng. Cycl.* "*Zodiac.*"

"The Egyptians, on whose early monuments the signs are found, acknowledged that they derived their astronomy from the Chaldæans. The Chaldæans attributed their science to Oannes, supposed to be Noah. The Arabs and Brahmins, among whom astronomy was early cultivated, seem to have derived it from Abraham, through Ishmael, and the children of Keturah. The Greeks supposed their imperfect knowledge of the subject came through the Egyptians and Chaldæans. The Romans are thought to have received through the Etrurians the names of the signs still in use among European nations. The Etrurians are considered to have derived them, with their other arts and sciences, from Assyria. The early Greek poet, Hesiod, is said to have made use of Assyrian records. He mentions some of the constellations by the names they now bear. Cleostratus [cir. B.C. 500] was acquainted with the signs, and wrote on Aries and Sagittarius. A later Greek poet, Aratus [B.C. 270], described the constellations such as we now have them, and by equivalent names. He gave neither history nor conjecture as to their date, their meaning, or their origin. They were to him, as to us, of immemorial antiquity. Cicero, in transcribing from Aratus, says, 'The signs are measured out that, in so many descriptions, Divine wisdom might appear,' but he does not say in what manner. No attempt is made by any of these writers to explain the figures, or to assign any inventor to them. The fables annexed to them must have been known to Cicero, but he seems to have held them unworthy of notice. None of these earlier writers allude to any tradition concerning the meanings of the names and emblems of the constellations, nor as to where, when, or by whom they were originated."

"Soon after the time of Cicero, these fables were collected by Hyginus, who characterises them as little to be depended on. Still, through his whole detail, may be traced the tradition of a Son of the Supreme Deity, sometimes as the conqueror of the serpent, sometimes as the suffering benefactor of the human race, dying by the serpent's venom. Often he is wholly divine and immortal, or is born of a human mother, dying on earth to live again in heaven; sometimes as a divinity, sometimes as a constellation."

"Nonnus [A.D. 600] afterwards sought to account for the signs by the twelve labours of Hercules. No two authorities are agreed as to what these twelve labours were, or in what order they were accomplished. At all times and in all places the order of the signs is invariable: they could not, therefore, have been borrowed from the labours, though these might have been, and probably were, borrowed from them. Macrobius, in the fourth century of the Christian era, fancied in them a possible suitability to the seasons of his age and country. He either overlooked, or was ignorant of the astronomical fact of the precession of the equinoxes, by which, if they suited Italy at that time, they could not have been adapted to those Eastern climates and remote ages to which he attributes their invention."

"Though the signs are found nearly as we now have them on early Egyptian monuments, no Egyptian explanation of them has yet been discovered; but from the various minor emblems accompanying them, it should seem the Egyptians themselves attached to them some meaning. It has been thought that in Aquarius might be traced some allusion to the inundation of the Nile; but here again geology interposes. When the summer solstice, and consequently the inundation, would have taken place in that sign, man did not exist; after his creation, when these stars would be seen at night, at that season, could it be traced in a slender stream poured into the mouth of a fish? If a symbolic meaning be given to one of these figures, the rest should be taken as equally significant; if one be interpreted of the seasons, so should the others. If one be taken as seen at midnight, so should the remainder. But it will be found that when any one of the signs is made to coincide with any particular season, there is seldom a plausible explanation to be given of another, and never of all of them. If the Nile overflowed under Aquarius, the harvest of Egypt could not take place under Virgo, nor either equinox under Gemini, as has been sometimes supposed. Could these difficulties be overlooked, and the inundation be imagined to be figured where the Egyptians have not traced it, would it not remain to be told why events which every returning year brought in due succession should need to be typified among the stars of heaven? Has it been usual to institute memorials of what cannot be forgotten, or to take precautions against overlooking what is present to the senses?"

"Some record of the past, some admonition addressed to the future, has ever been the purpose of such aids to memory. Some such origin might, therefore, have been looked for in these names and emblems, even if to it they had not borne internal testimony. Invariably connected with the most striking, the most sublime appearances in the visible creation, seen in all climates, accompanying the wandering tribes of man in all their migrations, the only unchanging, the only fixed among the objects of his senses, should we not expect to find among the names and figures annexed to the stars some memorial of great and universal importance to the whole human race? Guided by the inspired writer, should we not confidently look up to the starry heavens, expecting to trace in the names and symbols universally and from all antiquity associated with them, some signification that shall verily be found to declare the glory of God?" *

"In whatever obscurity the origin of the emblems of astronomy may appear to be enveloped, in the traditions of the nations where they are preserved, no such doubts hang over that of the science itself. It has always and everywhere been traced back to the earliest race of man. The Hebrews, Chaldæans, Persians, and Arabs imputed its invention to Adam, Seth, and Enoch; the earlier Greeks to their mythical and mysterious personage, Prometheus. Soon after the usual date assigned to Noah's flood astronomy is found in high cultivation in the commencing empire of China; and equally early records of observed eclipses were preserved at Babylon, proving considerable attainments in that science. Those modern writers who acknowledge the authority of the Hebrew Scriptures, if only as historical, generally refer its origination to the antediluvian patriarchs, and to Noah its transmission to the ancient nations. Those who do not admit that authority claim for astronomy, from its internal evidence, the antiquity of between five and six thousand years. There is no appearance of the science ever having existed separate from the emblems; and as they are in no way essential to it, their constant connection with it can only be explained by their having been invented at

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* "Like others of the sceptic school, Volney reports everywhere in antiquity the existence of the tradition of the expected conqueror of the serpent, a divine person, born of a woman, who was to come; and sees this tradition reflected in the constellations, but why it should be there he does not say. He inclines to think the constellations referred to the seasons, but as to what the serpent could have to do with those seasons, he offers no conjecture; the only point on which he is very decided is, that the seed-bearing woman of the Zodiac figured the harvest. That the harvests in different countries are at different times he overlooks, and also that in the same country the lapse of ages would transfer the time of harvest from one sign to another. When the summer solstice was in Leo, or even in Cancer, Egypt was under water in Virgo. The Nile, says Herodotus, rises for a hundred days and sinks for a hundred more. During those days there could be no harvest. It is only in modern times and more northerly climates that the time of harvest is while the sun is among the stars of Virgo. In Egypt and Palestine, in the time of Moses, the corn was in the ear at the time of the passover, at the vernal equinox, then just entering Aries. There was, then, some other reason than that of the harvest for the figure of the woman bearing the ear of corn, even that it set forth the prophecy of the seed of the woman who should come to bruise the serpent's head. Volney, seems also to have traced some idea of analogy between the sun and the expected conqueror of the serpent; but the sun is not the enemy of serpents, they are fostered by his rays. The true analogy he did not perceive; the sun comes, enlightens, blesses, goes away, but surely comes again. Thus, the sun of this world daily teaches, daily prophesies of the Sun of Righteousness, arising with healing on his wings, setting as it were for a while, but surely to return in the glory of morning to renew the face of the earth."

the same time and by the same persons. Why did those inventors adopt those particular emblems, when others might equally have marked out the division of the sun's path by that of the moon? It has been pointed out that with the phenomena of the circling year they cannot be consistently made to agree, nor with those of the climate of Egypt. The mythology of the nations, though reflecting their shadow, will be found insufficient to account for their imagery. If these traditional names and figures can be shown to symbolise prophecy, as imparted in the earliest ages, sufficient reason appears for the selection of such images, at such a time, and by such persons as those primeval fathers of mankind, with whom the science has always been supposed to originate."

"Sublime as is the study of those supremest visible works of the Divine Creator, the host of heaven, far more sublime is the contemplation of the unspeakably greater work of redemption. That stupendous mystery, then first presented to the mind of man, might well predominate in the meditations of the newly fallen, the redeemed race. To the memorial of that invisible but transcending miracle they appear to have consecrated the splendours of the starry heavens. To the glory of Jehovah Sabaoth, the Lord of Hosts, of those multitudes of multitudes, the countless myriads of far-spreading orbs of light, have they dedicated the magnificent system of sacred hieroglyphics, arranged to His praise in connection with the 'stars of light.'"

"A remarkable testimony that then and with these inventors astronomy originated is extant and accessible. It is that of the learned Jew Josephus, who, living at the time of the destruction of the Temple by Titus, refers for his authorities to ancient writers whose names alone remain to us. He attributes the invention of the science to 'the family of Seth, the son of Adam,' when the life of man then extending to near a thousand years, they were enabled to ascertain from actual observation the return of the heavenly bodies to the same positions in cycles and periods, which in after ages it has required the labours of successive generations to verify."

"Adam, divinely led to give names to what he saw, must have had such for the sun and moon, and probably for the planets, whose movements would attract his notice. Those celestial splendours shone in the far-off and inaccessible heaven, the abode or the path to the abode of his Creator and Redeemer, whence Divine instruction and, yet more, Divine mercy, had descended upon him. Thither his eyes would reverently and most habitually turn; the starry world on high would be, if not the first, the most absorbing object of his contemplation, and astronomy would naturally be, as tradition declares, the earliest study, the first science, of mankind. Seth, the son of his consolation, and heir of his promises, the traditional father of astronomy, is said to have commenced its arrangement with that of the twelve signs. To Seth is also attributed the great period of the relative positions of sun and moon, the cycle of six hundred years, by modern computation found so wonderfully exact. In this no use is made of the fixed stars beyond the zodiac. Enoch, his descendant, with whom he was long contemporary, is said by tradition to have given names to the stars; the further development of prophecy that appears among the constellations annexed to the signs, above and below them, may then be referred to him. 'The family of Seth' thus devised, carried on, and completed this great work, which remains to us an unchanged memorial of their piety, their intellect, and the revelation which they were endeavouring to perpetuate. . . ."

"From the beginning of Genesis to the end of Revelation, as through the whole sphere of the starry heavens, the enemy is represented in the serpent; the Messiah in the seed, the lion, and the lamb. Everywhere He goes forth triumphant; yet every where He is seen the Bruised, the Pierced, the Lamb as it had been slain. If the words of that first revelation, as recorded in Scripture, do not convey the full disclosure of the work of redemption as indicated in these emblems, yet it is not said that such further light was withheld. The rite of sacrifice, showing forth the Lord's death till his first coming, was with them, and the faith of Abel, which applied it. To Enoch had been foreshown the coming of the Lord to judgment. If they were uncertain of the time of the 'sufferings of Christ,' as we are of 'the glory that should follow,' still they knew, for they have prefigured, that He should come, should suffer, and should reign."

"It might be expected from such an origin, from inventors so circumstanced, that the promised Redeemer, His actions, His enemy, and His people, would be the subject of every emblem annexed to the constellations visible in the north temperate zone, the primitive habitation of mankind. It would seem improbable that any reference less high, less holy, should be mingled with those of such surpassing interest."

"Should the tradition of the Divine, yet woman-born Conqueror of the serpent, crushing His foe, but suffering from its venom, be met with among all nations, it is only what might have been anticipated among the descendants of one common father. From the Grecian Hercules, half human and half divine, subduing the hydra, and dying from its poison; from the Indian incarnation of the Divinity, the virgin-born Krishna, slaying a serpent and wounded by it in the heel, to the serpent-worship of Mexico, and that of the woman-born and unfathered deity

Mexitli, this image is everywhere present, pointing to one origin of the tradition and of the race."

Though by some it has been suggested * that these mythological tales were derived from the constellations, yet it has not by them been even conjectured why the constellations should have been so designated as to give rise to these stories. If, however, they were so named to record the revelation made to the first fathers of mankind, their connection with the mythologies of the nations is explained."

Symbols of the Twelve Signs.

Aries. The lamb: of innocence, meekness.
Taurus. The bull: of power, rule.
Gemini. Twins: of union, entwining.
Cancer. The crab, or scarabæus: of holding.
Leo. The lion: of victory.
Virgo. The virgin, with the ear of corn: of seed or offspring.
Libra. The balance: of weighing.
Scorpio. The scorpion: of wounding.
Sagittarius. The arrow: of going forth.
Capricornus. The kid: of sacrifice.
Aquarius. The water: of cleansing.
Pisces. The fishes: of multitudes.

"However well known may be the general forms of the twelve signs of the zodiac, they are often, in some particulars, incorrectly represented, thus obscuring their leading ideas; as, in heraldic terms, Aries, the ram or lamb, should be *couchant*, while the bull and lion should be *passant*. Aries should be holding in his forefoot the band that unites the two fishes of Pisces, and also that with which the sea-monster or leviathan is bound; the Bull rushing on as if overthrowing, dispersing his adversaries. In the Twins, the first holds an arrow, the second a palm-branch. The Crab has been hopelessly corrupted, apparently from the scarabæus, the sacred beetle of the Egyptians, but preserving the idea of holding fast a possession. The Lion is coming, leaping forth, his foot over the serpent Hydra. The Virgin holds in one hand a palm branch, in the other an ear of corn. The Scales should be uneven, the northern exalted, the southern depressed. The sting of the Scorpion should be reverted, as in wounding; the Arrow coming forth; the Goat or kid sinking down, and having the body of a fish; the man pouring forth the water, standing, risen; the Fishes bound together and looking different ways. These emblems, even in some of the ancient Oriental zodiacs, lose their characteristics."—Part 2, pp. 54, 55.

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* "Dupuis and the writers of his school have done much to establish the facts that confute their inferences. Dupuis himself has collected ancient authorities abundantly proving that "in all nations the tradition had always prevailed, of a Divine person, born of a woman, suffering in the conflict with a serpent, but triumphing over him at last. This tradition he finds reflected in the emblems of the ancient constellations. He seems to take it for granted that because the stars themselves existed before the tradition, that therefore the emblems annexed to them also preceded it. Who, then, annexed those ideas to the stars, which certainly do not suggest them? When and why did such an annexation occur to the mind of man? These questions he does not anticipate, and assuredly he does not answer. He calls his attack on revelation, 'L'Origine des Cultes,' 'the Origin of Religions,' which he would find in the constellations. The defence shows that the first religion was the origin of the emblems of the constellations."

"It should be borne in mind that these constellations are not natural groups of stars, but arbitrary connexions of various stars by means of imaginary figures, sometimes so interwoven with each other as to be inseparable by the unaccustomed eye. This is particularly observable in the figures of the serpent, of which Sir J. Herschel complains, that 'the heavens are scribbled over with interminable snakes.' Even so are intertwined the wiles of the enemy with the course and history of redemption."—Part I.

"The primitive year began in the sign Virgo,* the stars of which would be seen most strikingly in the evening sky when the sun was in Aries, the splendid star still called by us Spica, the ear of corn, in the woman's hand, marked the leading idea, the Promised Seed. It is remarkable that in this sign, long before the Christian era, there was figured, in the Egyptian zodiac, a woman with an ear of corn in her hand, and below another female figure, holding an infant. In the next sign, Libra, we have His work, which was to buy, to redeem, figured in the balance weighing the price against the purchase. Then in Scorpio follows the indication of what that price was to be; the conflict, in which the seed of the woman receives the wound in his heel, while his other foot is on the head of the enemy, here figured by the scorpion, a venomous reptile, which can sting even while his head is bruised. Next we find the Archer, with his arrow going out from the bow, expressing that the promised Deliverer should be sent forth. Then Capricornus, the goat, the victim or sacrifice sinking down as wounded, showing that the promised Deliverer must be slain as a sacrifice. In Aquarius, we see the rising up and pouring forth of water, as to cleanse, and fertilise; showing that the sacrifice was to bring purification and benediction by means of the risen Messiah. In Pisces, two fishes are bound together by a band, which is continued to and held by the fore-feet of Aries, figuring the leading idea of union. The fishes represent the redeemed and purified multitudes of the Church before and after the first coming, in union with each other, and with their Redeemer. The subsequent sign, the lamb or ram of sacrifice, here not dying, but as it had been slain, is now reigning triumphant, with one foot on the head of the enemy, bound also by a band which that foot holds. We then see Taurus, the bull, also a sacrificial animal, but living, and in an attitude of victory. He who died in the kid is now alive again, and to Him all power is given. In Gemini, the twins, whether human, or of the sacrificial goat or sheep, the leading idea of combining, entwining, is equally conveyed, expressing the union of Divinity and humanity in the Promised Seed. Cancer, the crab, or beetle, holding fast its prey, or its nest, well conveys the image of tenacious possession by Him who has assured His purchased flock, that no man can pluck them out of His hand. Leo, the majestic lion, rending the prey, represents irresistible strength, and final separation between good and evil. His foot is over the head of the prostrate serpent, thus aptly closing the series.

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* It is not desirable to rest much on this tradition (see more under "Leo"). Whenever the sun is among the stars of Aries, Virgo is the first of the zodiacal signs to appear in the evening, thus leading to human eyes the magnificent zone, which as F. R. shows, in its symbolic meaning is so simply and yet richly expressive of spiritual truths. The Sun in Aries is suggestive of that mysterious and wonderful union of power and weakness exhibited in "the Word made flesh," the great purpose of God from everlasting, the theme of the earliest as well as of the latest prophecies. But the sun and these stars cannot be seen together. It is as each sign, commencing with Virgo, comes successively into view, that the development of the Divine plan from the earliest germ to the latest manifestations is silently proclaimed by these starry memorials. Compared with the fragmentary and incoherent, though often elegant fables of the Greek Mythology, there is a simplicity and a symmetry in the explanation which refers them to sacred tradition that speak for themselves, and, without any other arguments, powerfully commend it as the true one.

"Here, then, we have represented in action twelve leading ideas; twelve principal truths of Divine revelation:—

1. The seed of the woman shall come.
2. There shall be a price paid by Him for a purchased possession.
3. The price shall be a conflict with the serpent foe; and a wound in the conqueror's heel.
4. He shall be sent forth swiftly, surely, as an arrow from a bow.
5. He shall be slain as a sacrifice.
6. He shall rise again, and pour out blessings on His people.
7. His people shall be multitudes, and held in union with each other and Himself.
8. He who was slain, whose heel was bruised, shall rule, and shall tread His enemy under foot.
9. He shall come in power, triumphant, and have dominion.
10. He shall be the Son of God and the Son of Man, the victim and the ruler.

11. He shall hold fast His purchased possession, the reward of His work.
12. He shall finally put all enemies under His feet, coming with ten thousands of His saints to execute judgment upon all, separating the evil from the good."

The Twelve Signs, Arabic, Sanscrit, and Chinese.

	Arabic	*Sanscrit*[*]	*Chinese*[†]
Aries .	. Hamal, *lamb*	Mesha, *ram*	Pe Yaugh, *white sheep*
Taurus	. Thaur, *bull*	Vrisha, *bull*	Kin Nieu, *golden bull*
Gemini .	. Tauman, *twins*	Mit'huna, *a pair*	Shang Hiung, *two brothers*
Cancer .	. Saratán, *crab*	Carcata, *crab*	Kiu Hiai, *great crab*
Leo .	. Asad, *lion*	Sinha, *lion*	Sin, *lion*
Virgo .	. Sunbulat, *ear of corn* (Spica)	Canya, *a young girl*	Sha Niu, *house of Virgo*
Libra .	. Zubán (Mizan), *claw* (balance)	Tula, *a balance*	Tien Tchingh [‡]
Scorpio	. Akrab, *scorpion*	Vrischica, *scorpion*	Tien Kie
Sagittarius .	Kaus, *arrow*	Dhanus, *bow*	Gjin Ma, *man-horse*
Capricornus	Jadi, *kid*	Macara, *sea-monster, or marine animal*	Mu Thien, *mountain sheep*
Aquarius	. Dalu, *urn*	Cumbha, *ewer*	Pao Piugh, *precious vase*
Pisces .	. Hût, *fish*	Mina, *fish*	Shang Yu, *two fishes*

Sir W. Jones (*Asiat. Res.* vol. ii. p. 292) gives the following description of the Indian zodiac, by Sripeti. "The *ram*, *bull*, *crab*, *lion*, and *scorpion*, have the figures of those five animals respectively: the *pair* are a damsel playing on a *vina*, and a youth wielding a mace: the *virgin* stands on a boat in water, holding in one hand a lamp, in the other an ear of rice-corn: the *balance* is held by a weigher, with a weight in one hand: the *bow*, by an archer, whose hinder parts are like those of a horse: the *sea-monster* has the face of an antelope: the *ewer* is a water-pot borne on the shoulder of a man, who empties it; the *fish* are two, with their heads turned to each other's tails. All these go in their proper places."[§]

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[*] Sir W. Jones (*Asiatic Res.*).

[†] Martini, *Hist. Sin.*

[‡] The claws of Scorpio apparently occupy the place of Libra.

[§] A. W. Schlegel, in the dissertation already mentioned, says that Sripeti, a writer of a later age, embellished some of the figures after the Greek fashion, thus exhibiting a departure from primitive simplicity, and the plain meaning of the original words, but for which novelties the above description would have been superfluous. Canya (the virgin) is mentioned in the "Institutes of Menu" (iv. 69). Cancer and Pisces in the "Ramayana" (Book i.). The above-mentioned learned writer, who vindicates the antiquity of the Indian zodiac against Letronne, is persuaded that both these works were known throughout India in the 7th century at least, before Alexander the Great; how much earlier the age of Menu and Valmiki is to be placed it would be difficult to say. Sir William Jones conjectured for the former 1200 B.C. Amarasinha ("the immortal lion"), about 50 B.C., who is at the head of the extant Sanscrit lexicographers, mentions the *rasichakra* or circle of the signs as too familiar to require defining. "They are," he says, "Mesha, Vrisha,

Aries.

—*ἀρνίον ἑστηκὸς ὡς ἐσφαγμένον.*

"A Lamb, standing, as it had been slain."—*Rev.* v. 6.

"Wherever the zodiac is found, it always begins with Aries. . . From all antiquity, this sign has been figured as the sacrificial lamb or ram. . . In the zodiac of Dendera, it is figured as the lamb, being without the horns of the ram . . . The sun's place at the time of the crucifixion was undoubtedly in the head of Aries." F. R. thinks it was divinely ordered that, during the miraculous darkness, this constellation would be seen close to the sun. "The Triangle (situated over the head of Aries) was said by the ancient Greeks to contain the name of the Deity, and to be a most divine emblem" (Part 2, p. 132). "Aries has its fore-feet on the band of Pisces, and a hind leg on the head of Cetus." This constellation . . . opened the astronomical year, 2,000 years ago, as *Princeps signorum*, and *Ductor exercitûs zodiaci;* and bore the office for a similar period. The charge is now resigned to Pisces, for Aries has passed 30° to the eastward of the point where the equinoctial is intercepted by the ecliptic."—*Cycle.*, vol. ii. p. 52.

[Symbol of Aries, ♈, ram's horns].

Taurus.

בְּכוֹר שׁוֹרוֹ הָדָר לוֹ

"His glory (is like) the firstling of his bullock."—*Deut.* xxxiii. 17.

Taurus is now the second in the zodiacal march, though *only* 4,000 years ago he led the celestial signs, and continued to be their leader for 2,000 years (*Cycle* ii., p. 104). On the legends connected with this sign, Admiral Smyth observes, "the classical astronomers are, however, very weak in their mythological derivations and zodiacal origins." On etymological processes, as often conducted, he remarks in another place (p. 88), "thus etymologists dock and stretch words, and limbs of words, after a Procrustean fashion, to suit their own theories."

This is a suitable place to offer an improved translation of Job, xxxviii. 31, 32:—

"Dost thou bind the knots of Kimah,
Or the bands of K'sil dost thou loosen?
Dost thou bring forth Mazzároth in his season,
And Ayish and her sons dost thou guide?"

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and the rest." Medini, the next after him, gives *all* the names as in the above table. The *old* Indian zodiacs have in place of Sagittarius only a bow and arrow (or an archer); for Aquarius, an upright jar, and for Pisces, only *one* fish. The precise meaning of Macara is uncertain.—See Wilson's *Sanscrit Dict.* [The above is taken from Schlegel.]

The diversity of renderings in the first line arises from the word מַעֲדַנּוֹת *maadannōth* ("sweet influences," pleasures, delights) which high authorities, ancient and modern, take as a transposition for מַעֲנַדּוֹת *maanaddōth*, bonds. According to the above translation, the allusion is to the clustering of the stars in the one case, and their distance from each other in the other. The interrogation of the Almighty is, art thou he who didst originally thus concentrate and disperse these groups respectively, and so maintainest them? Kimah and K'sil, there is little doubt, are the Pleiades and Orion (K'sil here would signify a strong or mighty one). There is more uncertainty respecting Ayish (see *Gesen. Thes.*), which some think means Ursa Major, and others Capella. The former seems the more probable. Here, as in ch. ix. 9, the three most peculiar constellations are named. The Pleiades being the most beautiful cluster; Orion the grandest wide configuration of bright stars; and the Great Bear only second in splendour to it, and guided by no human power in its perpetual and conspicuous circlings around the pole.

[Symbol of Taurus, ♉, bull's head.]

Gemini.

Καὶ ὁ λόγος σὰρξ ἐγένετο.

"And the Word became flesh."—*John* i. 14.

"Some ancient forms of this sign are said by Hyde to have been two kids." "From its being the sign of St. Paul's ship, we see that it was esteemed propitious by ancient mariners." —*Cycle* ii. p. 180.

[Symbol of Gemini, ♊, two equal, vertical, and parallel lines, united at the top and bottom.]

Cancer.

Κἀγὼ ζωὴν αἰώνιον δίδωμι αὐτοῖς· καὶ οὐ μὴ ἀπόλωνται εἰς τὸν αἰῶνα, καὶ οὐχ ἁρπάσει τις αὐτὰ ἐκ τῆς χειρός μου.

"And I give unto them eternal life; and they shall never perish, neither shall any *one* pluck them out of my hand."—*John* x. 28.

"The scarabæus is thought to have been the original emblem in Cancer." In the fine copy of Albumazar's *Introductio in Astronomiam*, 1489, in the "Bibliotheca Lambethana," Cancer is represented as a large cray fish. (*Cycle* ii., p. 203.) In another work (1667) as a huge lobster.

[Symbol of Cancer, ♋, two claws.]

Leo.

— ὁ λέων ὁ ἐκ τῆς φυλῆς 'Ιούδα.

" The Lion that is of the tribe of Juda."—*Rev.* v. 5.

" Bailly says the zodiac must have been divided when the sun at the summer solstice was in 1° Virgo, where the woman's head joins the lion's tail .... Egyptian tradition in Macrobius has it that, at the creation, the sun rose in Leo, at the summer solstice, the moon in Cancer " .... " Julius Africanus says, that Petosiris and Necepsos, ancient Egyptian philosophers, also taught that, at the creation, the sun was in 15° Leo, and the moon in 15° Cancer. These signs are still in astrology called respectively the houses of the sun and moon .... There is a tradition that the creation was at the summer solstice. Four thousand years before Christ this solstice took place where the junction of Leo and Virgo is marked by the bright star Denebola." F. R. refers the figure of the Sphinx to the junction of these signs. " The Sphinx of the pyramids, if female, would refer to the woman in the sign Virgo, as united in the starry emblems with that of Leo. If male, as the Andro-Sphinx elsewhere met with, it still expresses the prophecy; it is there the seed, the infant, the son, who is emblematised in the man as the sacrifice—in the lion as the conqueror. He is so typified in the two-faced cherub of Ezekiel, xli. 18, 19, which is understood by Jewish authorities to have been the same as those of Divine ordination in Exodus xxvi. and 1 Kings vi. on the curtains of the Tabernacle and on the walls of the Temple .... Layard thinks the figure of a female sphinx is sometimes met with in the Assyrian sculptures .... The Krio Sphinx, or ram-headed lion, is common in the monuments of Egypt. It may be accounted for by the junction of Aries and Leo in one object of veneration; both typifying the same person in the intention of their inventor. It shows a tradition of Him at once the appointed victim and the future conqueror. In the book of Revelation, He is at once ' the Lamb as it had been slain,' and ' the Lion of the tribe of Juda ;' not that St. John adverted to the hieroglyphic, but that the hieroglyphic was taken from the emblems of the zodiac, embodying the earliest prophecies, with which the latest are in accordance."—Part ii., p. 92, &c.

Sir G. Wilkinson says, " It is needless to add, that Egyptian sphinxes are never female " (Thebes, p. 332.) According to him they signify the union of intellect and physical force. " Ptolemy calls *α* Leonis *βασιλίσκος*, from an opinion of its influencing the affairs of the heavens; whence comes its Latin name Regulus, a word which appears to have been first used by Copernicus as the diminutive of *rex* .... Schickard insisted that it represented the lion of the tribe of Judah, mentioned in the Apocalypse ....

The Arabs called this 'fiery trigon' *Kalb-al-Asad*, or lion's heart; and *Meliki*, or kingly; for this impression of greatness was as rife among the Oriental astronomers and their successors, as among their classic predecessors."—*Cycle* ii., p. 226.

[Symbol of Leo, ♌, a rude representation of a lion *salient.* The upper part being the head and fore-legs; the twist to the left the hind legs, and the right twist the tail. It has also been explained as the tail and hind-quarters.]

Virgo.

הִנֵּה הָעַלְמָה הָרָה וְיֹלֶדֶת בֵּן

"Behold, the virgin shall conceive, and bear a son."—*Is.* vii. 14.

"In the planisphere of Dendera, the woman as the sign, carries the branch: below is a woman holding an infant." "α Virginis is the Στάχυς, Spica, As-Sumbuleh, or ear of corn, of the Greeks, Latins, and Arabians . . . . Dr. Hyde, observing that the Orientals call Spica *Sumbuleh*, says, that this was the Σίβυλλα of the ancients. The Arabians designated her *adhra nedhifa*, the pure virgin."—*Cycle* ii., p. 297.

See a chapter on the Sibyl as connected with the sign Virgo. Mazzaroth, part ii., p. 93.

"We are told that, in Ogygian ages, and among the Orientals, she was represented as a sunburnt damsel, with an ear of corn in her hand, like a gleaner of the fields; but the Greeks, Romans, and moderns, have concurred in depicting her as a winged angel, holding wheat ears, typical of the harvest, which came on in the time of the Greeks as the sun approached this star."—*Cycle* ii., p. 297.

[Symbol of Virgo, ♍ represents branch and spike, according to F. R. part ii. p. 26. It might occur to one that it represents the back of the left hand—fingers and thumb, ♏, grasping an ear of corn, ρ. In the zodiac of Dendera, the woman has the ear in her left hand. Professor de Morgan observes ("Companion to the Maps of the Stars," &c. p. 63, note), "The placing of stars in the wings of Virgo is to us a strong presumption that the back of the figure was looked at."]

Libra.

—ἠγοράσθητε γὰρ τιμῆς.

"For ye were bought with a price."—1 *Cor.* vi. 20.

"The emblem of the scales or balance is found in all the Eastern zodiacs. In some it is said to have been held in the claws of the

Scorpion: whence Chelæ, the claws, was sometimes substituted in the West for Libra."

The Balance was by the earlier Greek astronomers the invariably denominated Χηλαί (*Arat.* 89), Chelæ, the claws, i.e. of the Scorpion. Geminus, who flourished, it is believed, about B.C. 80, is, as far as we know, the first Greek writer who distinguishes the seventh sign as Ζυγός, which is used by Ptolemy indifferently with Χηλαί. The term *Libra*, for which Cicero in one passage employs *Jugum*, was first formally adopted by the Romans in the Calendar of Julius Cæsar . . . the figure, it would seem, is derived from the East.—Smith's *Dict. Antiq.* "Astronomy."

Dupius contends, from its presence in the most ancient Indian and Persian zodiacs, that it is in reality as ancient as the rest; and indeed it is not unlikely that the Greeks may have derived their zodiac from some nation in which the term for scales was confounded with that for claws, either by a synonyme in the language itself, or by mistranslation on their part.—*English Cyclopædia.*

Possibly, in the primitive form of the balance, it may have had hooks or claws in place of scales, and thus, as it obtained the name of Ζυγά—beams, it may also have been designated by Χηλαί, or some equivalent word, signifying claws. When subsequently this became disused, it may have led to a confusion with the claws of Scorpio, and so account for the singular statement of Servius, that the Chaldeans had only eleven constellations in their zodiac. The reform by which the Romans replaced the true sign under the name of Libra was probably from information from the East, where changes and corruptions in such things are less likely to have occurred. (Buttmann was disposed to think that the Χηλαί had originally signified the scales of the balance, and were afterwards, by a misunderstanding, converted into the pincers of a scorpion.—Humboldt's *Cosmos,* vol. iii. note 195.)

[Symbol of Libra, ♎, the beam of the balance in equilibrium (parallel to a horizontal line), with the eye in which the tongue vibrates.]

Scorpio.

—*ἵνα διὰ τοῦ θανάτου καταργήσῃ τὸν τὸ κράτος ἔχοντα τοῦ θανάτου.*

"That by means of death he might destroy him that hath the power of death."—*Heb.* ii. 14.

"From some confusion of the Greeks, this constellation formerly occupied two signs of their zodiac; and the pulling back of the chelæ, to make room for the scales, by the Romans, is mentioned under *a* Libræ. The subject has been warmly contested among authors."—*Cycle* ii. p. 364.*

[Symbol of Scorpio, ♏; rough representation of legs and tail, the claws drawn in.]

Sagittarius.

'Ιδού, ἦλθε Κύριος ἐν ἁγίαις μυριάσιν αὐτοῦ.

"Behold, the Lord came among his holy myriads."—*Jude* 14.

"The meagre mythological story of this creature may be placed among the many proofs before us that the Greeks could not have been the first to give names to the constellations. : . . Sir William Jones traced the Hindu zodiac to have existed more than 3,000 years ago, when the sun entered Aswin."—*Cycle* ii. p. 413.

[Symbol of Sagittarius, ♐, arrow.]

Capricorn.

Οὐδὲ δι' αἵματος τράγων καὶ μόσχων, διὰ δὲ τοῦ ἰδίου αἵματος εἰσῆλθεν ἐφάπαξ εἰς τὰ ἅγια.

"Neither by the blood of goats and calves, but by his own blood he entered in once for all into the holy places."—*Heb.* ix. 12.

"The goat always has the body of a fish in all the Eastern spheres, and in those of Egypt. . . . The kid of sacrifice is here united with the fish, the emblem of the Church. This emblem has in modern times been supposed to indicate the winter solstice as happening in that sign; but it was not there till long after the fish-goat had been figured in ancient astronomy. . . . Like the other signs, it embodied a prophecy of Him whom the kid of sacrifice, from the fall of man downwards, has typified, and here shown as united to the church, His body."—Part ii. p. 129.

"The ancients accounted Capricorn the Xth sign; and when the sun arrived thereat, it made the winter solstice with regard to our hemisphere; but the stars having advanced a whole sign toward the East, Capricorn is now rather the XIth sign, and it is at the sun's entering into Sagittarius that the solstice occurs, though the ancient manner of speaking is still retained."—*Cycle* ii. p. 474.

[Symbol of Capricorn, ♑; goat's horns δ, and fish's tail v.]

* [The scorpion was perhaps chosen in preference to the serpent from the likeness of this configuration of stars to the reptile; from its occupying less space than the serpent; and because the latter was reserved for other asterisms in which its great length and foldings might be displayed.]

Aquarius.

Ὁ θέλων, λαβέτω ὕδωρ ζωῆς δωρεάν.

"He who willeth, let him take of the water of life freely."—*Rev.* xxii. 17.

"The urn alone appears in many of the Eastern zodiacs, with the man in others, as in the Egyptian."

"It had been immemorially represented as a man pouring water from a vase; but as Moslems are forbidden to draw the human figure, the Arabs represented this sign by a saddled mule, carrying on his back two water barrels."—*Cycle* ii. p. 511.

[Symbol of Aquarius, ♒ ; water streams.]

Pisces.

—ὄχλος πολὺς ὃν ἀριθμῆσαι αὐτὸν οὐδεὶς ἐδύνατο.

"A great multitude which no one could number."—*Rev.* vii. 9.

"The fishes in Pisces had, in some Eastern zodiacs, the heads of women. The band of Pisces is often mentioned in the Arabian poem of Antar as a separate constellation." The equinoctial colure now passes through Pisces.

[Symbol of Pisces, ♓ ; two fishes, united by a band.]

The 36 ancient extra-zodiacal constellations, or "Decans," are treated of in "Mazzároth," according to the arrangement of Albumazer, or Abu Masher (A.D. 800), who speaks of them as in the Persian, Egyptian, and Indian spheres. Three are allotted to each sign; and they are supposed to extend and amplify the action symbolised by the signs to which they belong. Into this it is not intended here to enter; but there are two remarkable groups, irrespective of the above arrangement, whose symbolism does not so much depend for its interpretation on the derivation of names, but is readily explained according to the views already set forth. The first is made up of Draco, Hercules, Ophiuchus, Serpens, and Scorpio, and reaches from the pole to the extreme limit of vision in these latitudes. The following is from the chapter on the Twelve Labours of Hercules, as agreeing with the signs:—

"The mythological Hercules has been considered as a personification of the sun, and his twelve labours as denoting its progress through the signs in the annual course. It seems that the fables insensibly grew out of the traditionary explanations of the starry emblems, given to the wonder-loving Greeks by the Phœnician mariners, or transmitted to them from their Phœnician or Egyptian ancestors. . . . The story of the divine Hercules, the son of the Supreme God, who came on earth to labour, to suffer, and to die, has too many points of resemblance to the great theme of prophecy, the promised Conqueror of the serpent, not to be at once referred to primeval revelation shedding a twilight ray on the darkness which covered the Gentile earth. The sun of this world, though its glorious image was too soon desecrated by idolatry, yet in some measure connected the perversion with the truth. The sun-god Hercules preserved many of the characteristics of the Sun of Righteousness who was to arise.

"He was said to have contended, soon after his birth, with two serpents, which he strangled. His subsequent victory over the one serpent, the Lernean hydra, at once carries us back to the original promise; but for the story of two enemies at once we must seek some other source. We may find it in the constellation of Hercules, kneeling on one knee, as from the wound in the heel, while his foot is over the head of Draco, and the united emblem of Ophiuchus, the serpent-bearer, sometimes called also Hercules, who not only holds the serpent with which he is in conflict, but has his foot on the head of another enemy, the Scorpion, from whom he seems about to receive or to have received the predicted wound in the heel. Had the emblems been taken from the fable, these two human figures would have been infantine, like those of Gemini; but the fable being derived from the emblems, finding them placed soon after the commencement of the ancient year, where Virgo holds in her arms the promised infant, might refer the struggle to the beginning of the hero's career. Two serpentine emblems accompanying the human ones in the constellations may be thus accounted for: that two periods of time, the wounding and the victory of the promised Deliverer, were to be represented in one symbol."

Draco, as is well known, was mythologically considered as the snake which guarded the apples of the Hesperides, or Western-Maids; according to Hesiod, the daughters of Night without a father. Primeval tradition, not unnaturally, has been recognised here. Hercules brought away these apples. Draco is mentioned, Job xxvi. 13.

By his spirit the heavens (were made) brightness;
His hand hath formed the fleeing serpent.

It is thus described as drawn on our maps, sinuous, or with many folds, as in motion. With this passage is often compared Virgil, Georg. I., 244: "Maximus hic flexu sinuoso elabitur Anguis," &c.

Here the huge snake in many a volume glides,
Winds like a stream, and either Bear divides.—*Sotheby.*

In Aratus, the constellation now known as Hercules is called Engonasin (*on the knees*). Müller (*Introduction to a Scientific*

System of Mythology, translated by Leitch) says: "It is particularly evident from him (Aratus), that to the Greeks, in most cases, the forms existed before their mythological names. For example, he describes Engonasis as a figure crouching on the knees, and with outspread hands, remarking, at the same time, that this is a form *which no one can distinctly explain.*" Succeeding writers show in what various and ingenious ways this was attempted. (p. 138.)

Ophiuchus (the serpent holder) was commonly regarded as Æsculapius, but sometimes Hercules. In this case, too, the form evidently existed before a name was found for it.

The second group consists of Cepheus and Cassiopeia, Perseus and Andromeda. This is explained by F. R. as symbolic of the deliverance of the church by the divine victor of the enemy, and of her enthronement to reign with Him. Perseus has been considered as pointing to an Oriental (Persian) origin (Gladstone's *Studies on Homer*, vol. i. p. 555). The name *may* be derived from the Zend, pârs, pure, bright; in which case it would mean the pure or shining one; and in favour of this etymology, it may be remembered that we find in Homer, Persē, wife of Helios (the Sun). Müller thinks that by these names of heroes and heroines, "it was meant to translate *Chaldean* appellations which may be borrowed from a similar fable in Oriental mythology." (Myth. p. 326.) The Arabic name of the star β in the head of Medusa, carried by Perseus, Al-Ghúl, the demon, is also remarkable. The Arabians called Perseus, *Hamil ras-al-ghúl*, the bearer of the demon's head; *a* Andromedæ, *Ras-al-marat al muselselah*, the head of the woman in bonds; Cepheus, *al-Multahab*, the flaming; and Cassiopeia, *Dhât-al-kursa*, the lady of the throne. (*Cycle* ii.) Andromeda and Cassiopeia with Virgo are the only female human figures in the sphere.

In this explanation of the zodiacal signs, it is assumed that the inventors were possessed of a fuller revelation than is actually on record in the early chapters of Genesis: nor are there wanting indications of this. The institutions of the sabbath, of sacrifice, the distinction between clean and unclean animals, it is not unlikely were accompanied by some degree of explanation not transmitted in the sacred writings. The precise phrase, הִתְהַלֵּךְ אֶת־הָאֱלֹהִים "*he walked with God*," only used of Enoch and Noah, has been considered by some as indicative of (besides ordinary communion) special light and revelations enjoyed by those men of God. Of the former, we have the prophecy quoted in Jude's epistle, a revelation not transmitted in the Old Testament; and there may have been other unwritten or even written revelations of those early times that have perished. We should not have known either, except from Heb. xi. 10, that Abraham's anticipations were so clear and definite; "*he waited for the city which hath the foundations*," &c.; and verse 19, he reckoned that God is able "*to raise even from the dead*." And if we had not the book of Job, we should not have imagined that dwellers in Arabia in the patriarchal ages possessed the light which that wonderful history evidences.

But it does not follow, admitting the above assumption, that the truths symbolised in the celestial figures were as sharply defined to the authors of those figures as they are to ourselves. If we suppose they understood the promised seed, in the primary intent, to mean a person, and one "to be born after a miraculous manner, to be the son of a woman, not of a man" (Pearson on the Creed, Art. iii.) this would imply a duality of natures (Gemini), and therefore a capability of suffering, and also power finally to overcome. It is, however, at least questionable whether so much is deducible from Capricorn, or the Fish-goat, as F. R. imagined. It cannot, of course, be affirmed positively that the zodiac and the sphere generally of the antediluvians have come down to us unaltered and uncorrupted; though it would seem that they have, upon the whole, especially the former, been remarkably well preserved; and some, remembering that no notice of the fish's tail is taken by Aratus, Eratosthenes, or Ptolemy, might be inclined to regard it, like the wings of Virgo, as a subsequent innovation. But its genuineness may be admitted without supposing that it involves the New Testament interpretation, Eph. v. 30–32, of the type in Genesis ii. 23, 24. The fish-goat is, perhaps, the ideal of a creature whose element is both sea and land; which can rise from the depths of the former, and climb the heights of the latter; and thus it may be regarded as an emblem of *resurrection power*, as well as of sacrificial virtue.

There are five representations of the enemy: Draco, Serpens, Scorpio, Cetus, and Hydra. The first three have been already noticed. Cetus, "the most extensive constellation in the firmament, occupying the large space to the south, under Pisces and Aries" (*Cycle*), is an apt emblem, as already observed, of the enemy under the feet of Christ and His Church. Hydra lies beneath Cancer, Leo, and Virgo. His tail is beneath Virgo; then the other signs follow in order, till we come finally to him again, and see his head beneath Cancer and Leo. Thus the entire zone is completed—the celestial panorama of redemption, which, commencing with the early promise, ends with its fulfilment in the bruising of the serpent's head.

The writer of Mazzaroth believed that she had discovered the explanation of every name and emblem on the sphere. For this, much has been made to rest on etymology and tradition. Without being prepared to go so far, some may be of opinion that her interpretation of the zodiac, regarded as a cycle of Redemption emblems, which admit of an easy and natural exposition, at once commends itself as true. Enough is also sufficiently obvious in some of the figures beyond the zodiac to corroborate the explanation of the latter, and to indicate the principle on which, probably, all the visible constellations were originally formed. Judgments may vary in details; but those who concur in the general view here presented will easily perceive that these spiritual memorials traced in the starry heavens must have had a special value in the antediluvian and the patriarchal ages. And they testify to the honour possessed by astronomy in its infancy—perhaps before a line of inspired truth had been written—of being the medium of recording the saving truths of Revelation, in so far as then understood. If such indeed were the associations originally linked with the host of heaven, before it was degraded to the purposes of astrological superstition and idolatrous worship, of mythological fancies and infidel theories, it well becomes the present cultivators of the most ancient and noble of the sciences above all to reverence and love the Scriptures; to recognise there what the profoundest analysis could not discover, nor the finest objective or mirror display; to be thankful for the much it has been given them to know, and to be humble in the consciousness of the much more whereof they are ignorant. They should feel self-reproached if privileged to discern more than others of the glories of the firmament, they are destitute of the *faith* of those who first marked out the heavens with symbols of glories in comparison greater far.

NOTE.—Wishing to obtain more certain information about the Chinese zodiac, I applied to a gentleman well qualified to afford it, whose obliging reply, however, came to hand too late to make use of in preparing the foregoing extracts. He writes, "I have carefully examined several Chinese Treatises on Astronomy, but, with the exception of one of quite recent date, find no reference to the names of the zodiacal signs you mention. On the contrary, the 28 Lunar divisions are mentioned in works of undoubted antiquity, and consequently are of very early date." I regret not to have space here for the whole of this valuable letter, but thus much will suffice to caution the reader against reposing full confidence in the antiquity of the Chinese zodiac, the which, and the names of the signs, my informant supposes were first introduced by the Jesuit Missionaries.]

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ROYAL ASTRONOMICAL SOCIETY.

Session 1867–8.

First Meeting, November 8, 1867.

The Rev. C. Pritchard, M.A., F.R.S., *President*, in the Chair.

Secretaries—Mr. Stone and Mr. Huggins.

The minutes of the last meeting were read and confirmed.

Ninety-nine presents were announced, and the thanks of the meeting given to the respective donors.

Edwin Storey, Esq., M.A.,
Samuel Courtald, Esq., and
Thomas M. Allmond, Esq.,

were balloted for, and duly elected Fellows of the Society.

The President, after expressing the pleasure he felt in again taking the chair, surrounded by such a body of eminent men, said that it would be necessary for him to occupy the attention of the meeting for a few minutes, before proceeding to the active business of the evening, while he referred to several matters connected with the Society. These communications would relate to their astronomical gains and their sadder losses, as well as to some points of great interest to Fellows of the Society. With reference to astronomical gains, it must be remembered that Astronomy was, like all sciences, progressive, but that its progress was necessarily slow; and although he had now no great discovery to relate, there was ample assurance that plenty of men were at work, and when this was so, they must, like the bees gathering honey, be making and storing up observations certain to be of great value. The one important fact he had to communicate, and which he did not know twenty-four hours ago, was that the 25-inch object-glass, which had been so long making by Mr. Cooke, was completed—an optical feat vieing with any that had been performed. On November 5, γ^2 Andromedæ was seen most distinctly divided, and with the spurious disks of the three stars of the system perfectly round. To those who know what a telescope is, and how the difficulties of making it are enormously increased with extension of aperture, this statement is enough. He believed that we had not only one optician in London who could make such a glass but several, and he mentioned the fact not to laud any optician in particular but to show that it was totally unnecessary to send out of England for any optical instrument whatever. Turning to our losses, which have been great, and in some cases irreparable, it should be remembered that in a society approaching its jubilee, we must expect that in forty-eight years most of the founders will be missed, and among such founders we have lost Sir James South. There are, however, great names still left of our original list, including Brewster, Babbage, and Herschel. We have also lost Lord Rosse and Lord Wrottesley, both former Presidents of the Royal Society. The former is perhaps the best known, but Lord Wrottesley's labours were also very valuable. It may be wondered why the name of Faraday, who has likewise passed away, should be mentioned here; but he was for ten years a Fellow of this Society, and although cosmopolitan in science as he was, he found his mission lay elsewhere, and left us the President hoped that, when the obituary of deceased Fellows came to be written, and ample justice was done to the three great astronomers previously referred to, the claims of Faraday would not be omitted. With respect to the affairs of the Society, the Council had during the year been working in the most harmonious manner, and got through a great deal of important business. In July last, they found that it would be possible in future to distribute the Transactions of the Society among its members without payment, and each Fellow might from this time receive the volume for the current year, and its successors, free of cost—subject to certain regulations as to personal application.* The volume for last year was also ready, and was the largest ever issued, and he believed there had never been a more valuable one. It contained Sir W. Herschel's "Catalogue of Double Stars," revised by his son, Sir John Herschel, assisted by Mr. Alexander Herschel, the grandson of Sir William. · It also contained the result of Mr. Dawes's long and laborious observations. This had been a most expensive volume to print. The members must therefore pay for their copies, which would become more and more valuable as time progressed. The Council had also decided on providing the Fellows with a double Index to all the papers contained in their publications. This, however, would be a work of time. The periodical meteors of this month are a matter of great interest, and the Council had done what they could to assist observers. Professor Hoek, of Utrecht, had sent 100 copies of a star map, having the radiant point in the centre, which were for distribution among the Fellows; but there was a sheet of the British Association charts for sweeping, incomparably the best for amateurs to find the stars by, and copies of this were also printed; as also of the chart prepared by Mr. A. Herschel, showing the paths of the meteors seen last November, all of which the President hoped would prove useful; and having congratulated the meeting on Mr. Carrington's restoration to health, said he would no longer detain them from the reading of the Papers.

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* These will be found on another page.

On the November Meteors: by the Rev. A. W. Deey.

Now that the time for the recurrence of these bodies is approaching, it becomes a matter of interest to consider whether we shall have only the ordinary appearances, or a display which may vie with that of last year. Letters in the papers suggest that the latter will be the case; but the author thinks that this opinion, when subjected to examination, is of very doubtful value. His arguments are twofold. The first is that all the accounts of preceding showers have been confined to two successive years, and as Mr. Alexander Herschel describes a fine shower in 1865, and we had a finer in 1866, we cannot look for a third. The other point is, that, as the meteors in 1866 diminished in number rapidly after 13h. 15m., it is evident we passed through the tail of the stream, and coming later this year, it will probably be missed altogether. The author also suggests that, as Professor Adams found the period of 33·25 years, using his own radiant point, it would be interesting to know whether the adoption of the mean radiant point of all the observers would have made any difference in favour of the period of 354 days?

Mr. Stone: As to the last question, it may be said at once that it would have made no difference.

Professor Adams, at the request of the Chairman, said that on this head the alteration of the radiant point as described would not have made the least difference. The elements of the orbit would have been slightly modified, but the motion of the node would not have been changed. As to the argument that, as the meteors diminished after one o'clock, we were near the end of the stream, it is founded on a misapprehension. I do not think the display this year will be comparable with the last, but not for Mr. Deey's reason. The increase up to one o'clock and subsequent diminution were on account of the meteoric stream being a thin stratum of great length, but small thickness. The Earth met this stream, and passed across it, but this says nothing as to its length; but the depth being limited, we got through in a few hours, and the middle of the stream having the meteors thicker, the progress to a maximum and subsequent decrease necessarily resulted. The use of any particular radiant point does not control their re-appearance; this is a matter of local time. The other point, as to the recurrence in three successive years, is a matter of historical evidence, and can only be found out by observation; but I believe there have been such displays three years in succession; but we are not well situated for seeing the meteors this year. They will have a better chance in America; but here they will be later than in 1866, and near our daylight.

Mr. Brayley pointed out for the consolation of observers, next Thursday, that after the display of 1832 there had been other fine ones in 1833 and 1834.

The President: There is therefore ground of hope for a brilliant recurrence.

Mr. Brayley: Whether it will be large or small, I can't say.

The President: At all events, we must sit up for them.

Captain Noble thought that the radiant point had been sufficiently observed; but there was another matter which had not received the attention it merited. This was the height of the meteors. He had determined, if he saw some brilliant meteors, to employ a ship's quadrant to measure the distance of the nucleus or point in the persistent trace from two conspicuous stars, and, by comparison with similar measures, thus get the height.

The President: At Cambridge they have a very nice instrument for this purpose.

Captain Noble: Then I shall be happy to co-operate with Professor Adams.

Professor Adams: How will you measure from the nucleus in motion?

Captain Noble: Perhaps I used a wrong term. I mean by nucleus the bursting point.

Suggestions for Observations of the total Solar Eclipse of August 1868: by Mr. Johnstone Stoney.

The author referred to a Paper of his which had been read to the Royal Society, on the "Physical Constitution of the Sun and Stars." This contained suggestions for observers of the eclipse; but fearing that the Paper might not appear in the *Philosophical Transactions* in time, he had forwarded the present hints for the occasion, with the necessary elucidatory explanations. He had shown that it was probable the gases in the solar atmosphere were situated at different distances from the solar photosphere, the hydrogen being outside of all, while the sodium, magnesium, iron, nickel, &c. ranged nearer to the surface. These various metallic gases intercept the rays of light coming from incandescent substances of the same kind, and thus produce the dark lines of the spectrum. If the corona be due to such an atmosphere, it will shine partly by light borrowed from the photosphere, and partly by the light of its own luminous gases. The first would give a spectrum like the usual solar one, but the luminous gases would produce bright lines coincident with the black ones of Fraunhofer, if they can be rendered evident at all, and if this spectrum could be observed with a system of curved lines or wires in the apparatus, the height of the various strata of gases would be determined. Outside the photosphere, there appeared to be a circle of faint light, which was shown in Mr. De la Rue's Eclipse Photographs of 1860. This should be carefully observed. It was not likely there would be many spots on the Sun, but those visible should be observed before and after the eclipse, to see if there were any relation between them and the red clouds. The records of the eclipses of 1842 and 1851 should be studied in order to see what phenomena were then observed. Possibly there might be a connection between spots and cyclonic movements on the solar surface similar to our tropical hurricanes—the regions affected being nearly the same. The red protuberances were probably metallic clouds caused by the condensation of the vapours where the gases kept apart by the high temperature came in contact. The spectra of these protuberances are therefore of the greatest importance, and the observer might usefully prepare himself by passing some little time previously in a darkened room. The zodiacal light would be well seen at the time and place, and should be examined with the spectroscope before and after the eclipse.

Mr. Brayley was very glad to find the views which he had already enunciated as to the observations to be made during the eclipse supported by Mr. Stoney, although he must at the same time take the liberty to doubt the reasoning by which those views were supported.

The President: The Council have done their best to promote the interests of science on this occasion. The Government has accorded a considerable sum of money, which is being appropriated under the auspices of Major Tennant. Instructions had been already sent out to Captain Herschel, who would be associated with Major Tennant in organising the expedition, and it was hoped that success would attend some of the observers, and that by the spectroscopes the nature of the corona and red protuberances would be determined. The Royal Society was also busy organising an expedition.

On the Annual Parallax of Sirius: by Mr. Cleveland Abbé.

This paper, founded on 136 observations made at the Cape of

Good Hope, deduced $0''.27$ for the parallax of Sirius, with a probable error of $0''.1$.

On the Lunar Crater Linné: by Capt. Noble.

Since the publication of Mr. Birt's first paper in the *Monthly Notices* up to nearly the present time, I have kept a sharp watch on Linné, but until quite recently with only negative results. Where Beer and Mädler drew a crater, I could see only a white spot with ill-defined edges. Subsequent to Mr. Huggins's paper, I have also looked in vain for the small crater. It was, therefore, with no small surprise that at 5 P.M., on Sunday, November 3, I saw Linné appear like any other crater with low walls. The interior was of precisely the tint of the surrounding Mare, and altogether the object reminded me very much of the annular nebula 57 M Lyræ. The powers used were 164 and 255 on my 4·2-inch Ross equatorial. I enclose a sketch of the crater, and its shallowness was proved by the contrast of its grey interior with the black shadows filling the small deep craters to the south of it.

Captain Noble added that, so much having been said about the changes in this crater, he had come to the conclusion from the result of his careful and continued observation that its appearance was a matter of atmosphere, libration and illumination, and that it had undergone no change.

Occultations of Stars by the Moon, observed at Maresfield: by Capt. Noble.

On the Eclipse of the Moon, September 13, 1867: by Capt. Noble.

This paper contained the times of contact, egress, &c. and the author mentioned that, whereas Mr. Browning had published an account in the *Astronomical Register*, stating that the Moon had no unusual colour whatever, he had seen the shadow of a warm grey, and the limb north of Aristarchus of a strong copper tint. He did not see why 40 miles of distance should make such a difference.

Mr. Lockyer enquired whether Capt. Noble observed the Moon long after making his drawing of Linné at five o'clock.

Capt. Noble: Not long after.

Mr. Lockyer: At 8h. 30m. Linné was very difficult to see at all. It was only a white patch, so that three hours and a half made a great difference.

Capt. Noble: My reason for sending the paper was to show that with an object so much looked at by me, and the crater never seen before, I think it must be a matter of illumination and not of change.

Mr. Buckingham: I had intended to send the Society a paper on Linné, but it is not yet prepared. I have, however, here the notes of very numerous observations which furnish great evidence of change. On August 6, I saw a convexity of the white cloud. I then saw it enter the terminator, and it appeared an egg-shaped convex disk. On October 19, I saw parts of the whole ring and fragments of a broken ring with my 20-inch refractor. On November 5, I could still see the summit of the small crater, which seemed larger than before. I have made many measures of this, and they are generally rather smaller than those of other observers. I conceive the crater is considerably larger than at the beginning of the year, and nearer the centre of the cloudy spot than it was then. I should like to hear Mr. Huggins's opinion as to this.

Mr. Huggins said he could not confirm Mr. Buckingham's views, as his impression was that there had been no change, but he had not measured Linné since July.

Mr. Chambers: I met Mr. Prince, of Uckfield, and he told me he had seen Linné as a crater at 5h. 30m. on the night of Capt. Noble's observation.

Mr. De la Rue: There is an article by Mr. Proctor, in *Temple Bar*, in which he draws the inference of change in Linné from the photographs of the Moon taken by myself and Mr. Buckingham, but I must say they do not support his views.

Mr. Buckingham: I should like to ask Mr. Huggins whether he has compared the size of the crater in Linné with some of the very small and deep craters near it, or in the Apennines.

Mr. Huggins: I have not done so. When I could not measure it, I compared its diameter with that of the white spot, but the definition of this is very irregular, and we see more or less at different times.

Mr. Buckingham: I have a strong impression that Linné has changed since the early part of the year, especially when seen with a high power.

Mr. Huggins: I find 500 the best on my telescope for it.

Mr. Lynn stated that he had recently received a letter from Herr Schmidt, communicating some later observations of Linné. It appeared that Schmidt had not been able to see the small crater: and he sums up his observations with the remark that in the place of the former deep and broad crater, there is only to be seen now a bright spot, *not a depression*, and a small hill. Mr. Lynn remarked that Linné had been recently so well observed that there was no doubt about its present appearance, and the point really in uncertainty was the nature of the observations of former years, and particularly whether Beer and Mädler's measurement of the diameter (1·4 German miles) related to the crater itself or to the whole bright patch, which appears now to possess about that diameter. He begged also to call attention to the fact that the letter from Professor Mädler to Mr. Birt, printed in the June number of the *Monthly Notices*, scarcely affects this uncertainty, as it is almost in the very words of "Der Mond," and is evidently a transcript of the same notes in which the passage concerning Linné in that work was founded.

Capt. Noble: I saw no little crater, but just what I have drawn, a ring instead of a white cloud, as if a veil had been removed, and the similarity to the annular nebula struck me at once.

Mr. Huggins: I have seen it several times like the drawing when the high western wall was visible.

Mr. Browning: With regard to the colours at the eclipse, I have reason for thinking that the lunar tints are much less visible with large apertures than with small. I believe Mr. Huggins thinks so too, and I hear from Mr. With that with 12 inches aperture he saw none. I do not speak positively, but I saw no special colours. Capt. Noble has said that observing 40 miles apart is no reason for a difference in colours, but it seems to me that atmospheric and other conditions might greatly vary at such a distance.

Mr. De la Rue: With regard to the question of colour, Major Tennant and I observed the eclipse, and photographed it. In the early stages, there was little colour, but afterwards it became ash-coloured and coppery in both my reflector and an excellent Dallmeyer refractor. I also saw a small star occulted during the eclipse which does not seem to have been noticed.

Capt. Noble: I saw the copper-colour brightest about 12h. 42m. With respect to Mr. Browning's remarks, while admitting that atmospheric conditions may differ in two places, what I meant to imply was that, if there were a physical cause for the colour such as refraction by the Earth's atmosphere, this could not be affected by parallax.

Mr. De la Rue: It is very remarkable that many details of the lunar surface are better seen during an eclipse than at any other time.

Mr. Buckingham: I observed the eclipse with Mr. Dancer, of Manchester, and we took 32 photographs. It is very remarkable that part not obscured at all to the eye or telescope was absent from the photographs, as if something cut off the actinic rays.

Mr. De la Rue: I have before called attention to the fact that more of the moon is eclipsed chemically than optically.

Observations of Jupiter without Satellites: by Mr. Hough.

These observations were made at Lord Wrottesley's observatory. The shadows of three satellites and two satellites themselves were seen projected on the disk of Jupiter.

On Jupiter without Satellites exterior to his Disk: by Mr. Burr. The author observed the planet at the observatory of Mr. Slack, Camden Square, N.W. with his 6½-inch silvered glass mirror, mounted equatorially by Mr. Browning. Notwithstanding the very unfavourable weather preventing any views till near ten o'clock, the shadows of the 3rd and 4th satellites were then seen, and the 3rd satellite itself of a brown tint between them, the shadows being intensely black. The 1st satellite was then shining outside the disk, but soon passed on, when its shadow became visible, and some glimpses of the 4th satellite were also obtained through the drifting clouds, making five dark spots altogether, the 4th satellite being as black as any shadow.

On Jupiter without any visible Satellites: by the Rev. W. R. Dawes.

The 1st satellite before transit was two or three times brighter than the 4th. The 3rd, 4th, and 1st satellites were visible on the disk with their shadows making six objects, of which the first satellite only appeared as a bright spot. Contrary to expectation, the shadows were equally black all over, no difference due to penumbra being visible at their edges, but possibly the contrast of the bright disk of the planet prevented any shading off being seen. The 4th satellite was as black as its shadow, no irregularities being visible on its surface, but the 3rd satellite had its N.E. side very bright, and the opposite part nearly as dark as its shadow. The shape of the spots on this satellite strongly reminded the author of the configuration he had formerly drawn, but this must have been the other side of the satellite. Occasionally a bright channel between the two dark portions could be seen. The power used was 212.

Mr. Stone: Everyone was struck by the inky blackness of the 4th satellite.

Captain Noble called attention to the very great errors of the times of eclipses of Jupiter's satellites as given in the *Nautical Almanack.* They were calculated to fractions of a second, giving the impression of great accuracy, but he had found them five minutes out, and with the 4th satellite as much as eleven minutes, so that the result of any attempt to use them for determinations of longitude might be imagined.

Mr. Stone believed that fresh tables were being calculated, which, when used, would enable these phenomena to be accurately predicted.

Determination of the Latitude of the Observatory at Toronto, Canada: by Mr. Kingston.

The author, having only a portable transit, and from the construction of the Observatory not being able to use it in the prime vertical, employed the levelling screw under one of the Y's, of which he carefully ascertained the value as a micrometer, and then, after adjusting the level and collimating, observed zenith stars by tilting the transit with the foot screw so as to bring the wire to the stars, and deduced his latitude with a probable error of $0''\cdot7$.

The President and Mr. Stone complimented the author on his ingenuity—necessity being the mother of invention.

A Letter on the Newton and Pascal Controversy: by Professor Grant.

This letter gave an epitome of those written by the author to Mr. Leverrier, in which he pointed out that the state of practical astronomy in the time of Pascal was utterly inadequate to produce the results given in the alleged letters, and which were identical with those in the third edition of the "Principia," deduced from the observations with the excellent instruments then in use. The solar diameter and parallax were taken as examples, and it was evident that the results obtained by Galileo and others, at the date of the letters, were merely vague conjectures, the telescopes then in use not being suited for the work; and it was concluded that it was unnecessary to pursue this contemptible affair further.

On a form of Observing Chair: by the Rev. W. R. Dawes.

Photographs and a description of this were sent, Mr. Dawes considering it the most convenient form he had met with.

Mr. Buckingham wished to mention that he had lately discovered some acolytes of Vega. One which had been originally found four years ago had been repeatedly seen with the 20-inch object-glass, although it had become fainter now. On the 18th May, he had discovered another rather brighter than the first, and nearly at right angles to it, the first being in a line towards the old comes (43″ distant). The first had decidedly changed position in the four years, but was too faint to bear illumination for measurement. Quite lately another had been found preceding α Lyræ at an angle of 295°. On 17th July last, the Rev. Mr. Crowe, of Huddersfield, saw both the two first with the 9-inch refractor. The third was picked up about a month after. It was brighter than either of the other two, but this only amounted to one-third the light of the companion of Sirius. The object-glass and eye-piece had both been rotated to avoid any optical delusion.

Mr. Penrose had seen one of these companions with a 5½-inch object-glass.

Mr. Browning had looked for these stars with 10 and 12-inch mirrors without success.

Mr. De la Rue: I will send the place of a companion of Vega, which I have often suspected to exist. In looking for these delicate points of light, not only should the object-glass be rotated as mentioned by Mr. Buckingham to test their reality, but the object should be observed in different parts of the heavens as flexure of the telescope tube may be concerned in their production.

The meeting then adjourned.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

CARL'S "REPERTORY OF COMETS."

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—In the November number of the *Register*, under the "Brief Correspondence," G. F. C. asks for a sketch of the plan and character of Carl's *Repertory of Comets*. I the more willingly ask you to furnish him and your readers generally therewith as I think the work should be better known in England.

"Repertorium der Cometen-Astronomie" is by no means a readable book, as the phrase is, but is a laborious and careful collection of references to the observations and orbital determinations of all known comets, with the places in the publications where they are to be found. It is therefore of the utmost value to anyone making investigations into cometary orbits. The author remarks in his preface that he has laboured to furnish a preparatory work to a complete Cometography from its present stand-point, such as Pingré left so excellent an example of for his own time, which work has indeed been used as a basis in the early sections of the one in question.

I will give two examples of the amount of mention he has given of recent comets, selecting Comet III. 1862 (as he calls it, counting the apparition of Encke's Comet for that year as I. 1862) from its interest, as having in all probability some close connection with the Perseides, or August meteors, and Brorsen's periodical comet, because an apparition of it is due next summer.

Of the first he says (p. 316):—"1862 III. Discovered on the 18th of July, by Tuttle, at Cambridge (North America); on the 22nd of July, by Pacinotho and Toussaint, at Florence; on the 25th, by P. Rosa, at Rome; and on the 26th, by Schjellerup, at Copenhagen."

Then follows a list of all the places at which it was observed, with the dates of first and last observations, and reference to the publications where all may be found—seven sets of elements (with references also to all others), of which Hornstein's give a period of 124 years, and Schmidt's values of the apparent length of the tail at different times.

At page 356, he thus speaks of Brorsen's Comet:—"Another Comet with a period of about 5½ years was discovered by Brorsen, at Kiel, on the 26th of February, 1846. It returned to perihelion in September 1851, but without being seen: it was, however, repeatedly observed at its next return, in the year 1857. Hind then showed that the present orbit of Brorsen's Comet was a consequence of the attraction of Jupiter, which planet it made a near approach to in May 1842. D'Arrest (*Astr. Nachr.* vol. xlvi. p. 101) has more closely investigated this question, and given the following set of elements for the orbit of the comet round the sun before the occurrence of the great disturbance by Jupiter in the year 1842.

"Epoch 1842, April 19, 12h. Berlin.

	°	′	″
" Long. of perihelion	133	26	43
Long. of asc. node	107	44	2
Inclination	40	50	59
Eccentricity	0·592751		
Perihelion distance	1·501304		

"This comet shows, therefore, an analogy with Lexell's Comet (1770 II.), in which, however, the transformation of the orbit was yet much more considerable. The comet will, according to D'Arrest's calculations, continue within our reach almost until the middle of the next century, after which it will again take up a different orbit."

Then follows his usual list of all the places at which the comet was observed, at the only two appearances at which it was seen at all (those of 1846 and 1857), with dates and references.

Since I wrote you on the subject of "the hundredth planet," you are doubtless aware that Professor Watson, of Ann Arbor, has added two more to the known list, which he discovered on the 24th of August and the 6th of September. These make up the number of minor planets to 94, fifteen of which have been discovered in America, commencing with Euphrosyne in 1854, at which time 31 only were known.

I am, Sir, yours faithfully,
W. T. LYNN.

Greenwich, Nov. 6, 1867.

THE PLANET NEPTUNE.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I should much like to know (through the medium of your excellent *Register*) whether the planet Neptune can be *seen* through a good opera-glass if one knows exactly where to look for him.

In the *Register* for September, Mr. H. E. Lowe says that this distant planet has lately been in the "field of view," along with 77 Piscium; I have therefore *hunted* in that neighbourhood, and soon found a small star of about the 7th magnitude, which forms an almost perfect triangle with 80 and 77 Piscium. I thought, *at first*, that this star was the planet which I was seeking; but after several watchings I cannot find that it moves.

I should feel obliged if some of your readers would kindly inform me in your next issue what star this can be whose position I have roughly described, and whether Neptune shines as a star of the 7th, 8th, or 9th magnitude; and are there any good star maps that embrace all those magnitudes?

As I have not an equatorial, I trust that you will kindly insert this letter, that I may obtain the desired information.

I remain, Sir, yours faithfully,
W. L. L.

Hackney: Nov. 4, 1867.

JUPITER AND HIS SATELLITES.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I observed with much satisfaction the remarkable corroboration of my description of the double spot on the 3rd satellite, by the drawing given by Mr. Dawes in his interesting letter of the 22nd August last; and although in his letter of the 14th October last he does not corroborate my view of the coloured appearances indicated in my letter of the 9th September last, I can assure him they were clearly perceptible, not only to myself, but to the clergyman of my parish, who was with me for a short time, and to a youthful assistant of quick perception.

The darker shade or colour of the spot alluded to strongly resembled the colour usually left on a rough honeycomb sponge under the part cut off.

I saw the kind of apparent elongation of the 3rd satellite mentioned in Mr. Dawes's first letter, but nothing like the duplicates alluded to in his last, as not seen by him, the deceptive appearance of which I attribute to an optical delusion, such as may be noticed by anyone allowing his eyes to dwell for a second on a bright circular object, and then withdrawing them quickly to a darker ground, where an imaginary circle may be seen for a short time, I believe, by anyone, whatever may be the state of his stomach or nerves.

I could not detect any penumbra, or fringe-like appearance on the circumference of either shadow, such as that shown on Mr. Proctor's drawing, which I intended mentioning in my first letter, but accidentally omitted.

My 9-inch object-glass, which I used on the occasion, is that made by Cooke & Sons for the late Captain Jacob, and it bears well Mr. Dawes's focus test. I believe also its chromatic aberration to be small, allowing the right colours of stars to be seen vividly; and from the latter quality of my instrument, its large aperture of glass, with extraordinary freedom from flaws, and with the particularly clear sky with which I was favoured soon after I began gazing, I certainly think, though with great deference to Mr. Dawes, for whose very superior astronomical knowledge and experience I feel great respect, that the coloured appearance I saw arose from local atmospheric causes not immediately around my observatory, but around the planet itself. The unusual illumination of Jupiter was, I find, noticed by other observers.

I am, Sir, yours faithfully and obliged,
South Villa Observatory, near Worcester: THOMAS BARNEBY.
November 11, 1857.

"*THE LATE LUNAR ECLIPSE.*"

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—In a letter you favoured me by printing in the October number of the *Astronomical Register*, I averred that no colour was visible during the progress of the late lunar eclipse. This assertion requires the qualification —*in telescopes of large aperture.*

By comparing notes with various correspondents, I have found that most observers who used small telescopes found some colour on the moon's surface, although much less than is usual during eclipses.

Several careful experiments have shown me that the amount of colour on an object decreases with increase of aperture. The judicious application of stops will, therefore, greatly facilitate the detection of colour.

An account of the experiments I have made in connection with this subject would occupy too much of your valuable space, so I must reserve them for a communication to the Society.

I write principally for the purpose of stating how far I was in error in my first assertion.

I am, Sir, your obedient servant,
Upper Holloway: Nov. 16, 1867. JOHN BROWNING.

DOUBLE STAR MEASURES.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—There are only two points in the Rev. W. A. Darby's letter in this month's *Register* which seem likely to be of any interest to the astronomical public, one of which is the comparison of the magnitudes of γ *Andromedæ* and of δ *Cygni*; and the other, the dependence which, judging from experience, may be reasonably placed upon a small and rather rough woodcut, to represent accurately a careful drawing upon a small scale. And these two I shall treat as briefly as possible in closing my discussion of the subject.

1. The two objects above named are referred to by Mr. Darby as being of the "*same magnitude*;" and part of his criticism on my diagrams is founded on that assumption. My own observations have led me to a very different result, viz. that γ *Androm.* = 2¼ or 2½, and δ *Cygni* = 3 or 3¼: the difference between them under similar circumstances being about ¾ of the difference between the average second and third magnitude. From my own observations also, I aimed to represent the diameter of γ *Androm.* = 1″·5, and of δ *Cygni* = 1″·2: the scale of the diagram being 10″ to 1 inch.

Since reading Mr. Darby's letter, I have consulted the *Uranometria Nova* of that most accurate observer, Argelander, and find the magnitude he assigns to γ *Androm.* is 2·3 (expressed decimally), and to δ *Cygni*, 3·0: the difference therefore being 0·7 of a magnitude. Having also referred to Sir John Herschel's valuable sequences of magnitude in his *Outlines of Astronomy*, I am surprised to find no fewer than 32 stars in the northern hemisphere arranged between γ *Androm.* and δ *Cygni*: the difference being 0·74 of the difference of magnitudes 2 and 3—γ being rated (in the language of the ordinary scale) at 2·50, and δ at 3·24.

2. Mr. Darby assumes that it was my intention to draw the position-angles as well as the sizes and distances of the disks, with the greatest possible accuracy; and also that subsequently I "deliberately endorsed all (in the woodcut) except the comparative sizes of the disks, of the components of γ *Andromedæ*." Both these assumptions are inconsistent with the facts. The question at first started had reference principally to the *size of the disks*, and the *separating power of different apertures*; and the position-angles were only adverted to because the enormous error of above 100° in the diagram, representing Mr. Darby's observation as communicated to me, rendered it very doubtful whether the close pair had really been seen correctly. An approximate angle would have been sufficient to determine that point; and, as the angle in the woodcut did not appear obviously erroneous, I never examined it at all. Now, however, recollecting that I had taken some pains to make the angles nearly correct, I have examined my original diagram, and really find it so near the mark I aimed at that it would be very difficult for me to improve upon it. In conformity with my own results, I intended to draw the position of AB = 64°, and of BC = 108° (being my measure in 1866·9). It is true that the angles in the small and rough woodcut differ somewhat from these; but when it is considered that the radius, or central distance, of BC is only 0·06 of an inch, I think this can scarcely be wondered at. It would have required very fine and careful engraving on copperplate to attain to a much greater degree of accuracy.

In conclusion I would distinctly avow that, though I certainly object to a woodcut being taken as an undoubtedly correct version of a drawing on so small a scale, or perhaps on any, yet I am always sincerely thankful to anyone who will point out any real or supposed error I may make—for an opportunity is thus given of acknowledging and correcting a real error, or of explaining and removing an appearance of error.

I remain, Sir, your obedient servant,
W. R. DAWES.

Hopefield Observatory, Haddenham, Bucks:
Nov. 13, 1867.

P.S.—A densely clouded sky has unfortunately obscured any meteoric display which may have occurred this morning.

COLOUR OF JUPITER AND THE MOON.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—With reference to Mr. Browning's letter in the *Astronomical Register* for October, the edge of Jupiter generally appears to me fainter than the centre, though not so dark as the belts; but I suppose the fact that the satellites so often seem bright when seen against the edge, and dark when in front of the belts, is a proof that the edge is darker than the belts. Of course, the edge will look brighter than it really is on account of its contrast with the sky.

If Mr. Knobel often looks at Jupiter, he will find that the fourth satellite is seldom otherwise than the faintest of the four.

The Eclipse of the Moon.—In answer to Mr. Browning, the umbra upon the moon in the eclipse of September was orange, except near the edge, as seen with an opera-glass; but the colour was much plainer with a 5-ft. refractor. With a power of 80, about the middle of the eclipse, nearly the whole umbra was bright orange, contrasting greatly with the bluish colour of the bright clouds that flitted across it. The blue colour of the edge of the umbra was, however, more perceptible at 11·30 P.M., when there were fewer clouds; at that time the edge of the umbra was blue for a considerable width, but the darkest part orange. The blue may, perhaps, have been caused by contrast; but the orange could not.

I am, yours, &c.

Sunderland: Nov. 14, 1867. T. W. BACKHOUSE.

"SUBJECTS FOR AMENDMENT."

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The letter of Peter Pindar, A.R., in the last number, deserves, on the whole, to be commended; but exception may be taken to his too sweeping censure of "silly questions and enquiries." No doubt editorial discretion must be exercised here as in other points; but it would be a pity to spoil the free interchange of notes and queries by a tight-laced regard to the quality of the latter. It often requires some courage to ask a question, and no one likes to be *extinguished* for it by another who may happen to know a little better. One who is good-natured as well as gifted will sometimes meet a perhaps not very sensible enquiry with a felicity and breadth of treatment that, without mortifying the querist, makes others also glad that the question was asked. We are losing, one after another, our distinguished veterans in the Uranian legion. May the *Astronomical Register* continue to be a help to many of its rank and file! Who knows but one or another may be carrying the bâton of a field-marshal in his knapsack? The humblest are doing something by promoting the circulation of this periodical, which may be a sort of gymnasium, or nursery, to some who may turn out proficients hereafter, and who, albeit they may, in their early career, have sometimes asked silly questions, will bear in kindly remembrance the forbearance they met with, and imitate it in turn towards others, when in a condition themselves not only to put, but to answer, hard and wise ones.

Yours faithfully,

G. J. W.

THE ROYAL ASTRONOMICAL SOCIETY.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The Royal Astronomical Society is to be congratulated on the very happy inauguration of the session on the 8th. Our president supported well the dignity of his high position. He was most happy in his opening address and in his remarks throughout the meeting. All the members who presented themselves were courteously received, and seemed quite at their ease in reading their papers or making their statements. All the speakers (including the Mr. B.'s) seemed pleased themselves, and certainly they pleased the meeting, and added their quota in carrying on the great work of the Society. The questions from the chair, *after* a paper or a speech, were satisfactory to all. They were put in a good spirit, and tended to elucidate what had been stated, and as to Linné—that bellicose question was discussed by the conservatives, who are for no change, and by the movement party, who think they have ocular proofs of their contrary opinion, as men of science should discuss a doubtful matter.

As the science we cultivate is of such importance to the world, as it adds so much to the intellectual happiness and the social well-being of mankind, we cannot be too anxious concerning the great trust committed to the R.A.S. Not only its usefulness but its honour and its dignity should be dear to us. As regards our opening meeting on the 8th, the expressions of satisfaction, during our pleasant half-hour for tea and talk, were numerous and hearty. We are full of hopes for the future, and as to myself, my sword is sheathed, and my ardent wish is "pereat positum rubigine telum," and that your pages shall not be again troubled by me in my nom de guerre,

Nov. 12, 1867. PETER PINDAR, A.R.

REFRACTION ACCORDING TO "N."

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—I can only account for the further question, and the two diagrams of your correspondent "N.," on the supposition that he is not familiar with the distinction drawn by astronomers between what is called the *sensible* and the *rational* horizon.

The sensible horizon—that which is apparent to the optic sense—does not represent the convexity of the earth's surface, to which "N." calls our attention, but the point of that surface on which the observer stands; which point is the middle of the plane drawn by "N." in Fig. 1, where no object can reach the eye unaffected by refraction, excepting from the zenith.

To avoid the errors of refraction, astronomers calculate the true place of the heavenly bodies by the rational horizon, drawn through the earth's centre, as in Fig. 2; but this in no way affects any argument I have raised; and, as we have now mutually explained, I trust to be permitted to drop the subject.

Your obedient servant,
W. E. HICKSON.

Fairseat, Wrotham:
October 5, 1867.

REVIEW.

Life and Work at the Great Pyramid, during the months of January, February, March, and April, 1865; *with a discussion of the facts ascertained.* By Professor C. Piazzi Smyth. 3 vols. Edmonston & Douglas, Edinburgh, 1867.

In the above work, of which the main feature is that it deals with an authentic and contemporary astronomical monument, of an age far earlier than any of the Greek Astronomy, or than the Chaldæan either, of which we possess certain and contemporary proof, there will be found some interesting particulars bearing on the subject so admirably opened before our readers, and to modern astronomers generally, by Mr. George J. Walker in the appendix to our last number.

Mr. Walker there endeavours to set forth that the constellations were not invented by the Greeks, but had a far earlier, as well as holier, origin, and one towards which all Christians may look with intense satisfaction and joy. But most, if not all, of his data were conclusions only based on literary *assertions*, rather than *proofs*, of a long subsequent time.

Here, however, in the Great Pyramid, we have a scientific monument, which has come down to us with very little comparative injury from precisely that early and unknown time, of not only long before the Greeks, and before the first of the Babylonian and Assyrian inscriptions, but of before Moses, and before Abraham. What, then, does that most ancient monument say, touching this pre-Grecian and anti-pagan theory of the constellations?

The question is evidently one of the very highest importance in the present day, and it may be long before a full answer can be rendered; but meanwhile a beginning of the results seems to have been attained in the above-mentioned work, and will be found chiefly in its 3rd volume, pp. 240–293; pp. 489–495; and pp. 545–569: the length of which passages will excuse us from attempting to quote them here.

THE NOVEMBER METEORS OF 1867.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The reminiscences connected with the November meteors of 1866 are so numerous and impressive that I determined, notwithstanding the probability of the 1867 display being very inferior, or even altogether doubtful, to continue observations during the entire night, rather than miss an opportunity of observing any of the phenomena that might have occurred.

I commenced my watch at 10 o'clock on the evening of Wednesday, November 13, and continued it until 5.30 of the morning of Thursday, November 14. The Moon shone brightly during the whole night, the sky was filled by a delicate white semi-luminous mist, and stars of the first magnitude were alone visible. The only meteors seen by two companions and myself were one faint meteor at 3.45, and one rather brighter meteor at 4 o'clock.

I have since heard that two other meteors were seen about 3 o'clock A.M. Thursday, and one very bright meteor at about 5 o'clock P.M. Wednesday. At 4 o'clock A.M. Thursday, the sky became more thickly overcast with cloud, and at 5 o'clock stars and moon were entirely shut out from vision. The atmosphere continued exceedingly and unbrokenly clouded until the morning of Friday, so that all chance of seeing meteors, except such as closely approached the Earth, was entirely excluded; and no such large and closely approaching meteors are reported to have been seen in this locality.

As the maximum period of the meteoric display was expected to occur about 7 o'clock A.M. on the 14th, it is probable that, had the sky been clear, many meteors would have been seen, and this is the more probable as reports from France indicate that meteors in considerable numbers were seen there. We shall, of course, wait with great interest for reports from America, and it is to be hoped that atmospheric conditions were more favourable there than they appear to have been over the greater part of the British Isles. I am, yours obediently,

Newcastle-on-Tyne: Nov. 16, 1867. T. P. BARKAS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—The weather at Scarborough, which had been most dismal and foggy for some days, showed some signs of improvement on the 13th inst. though it was still feared that the night would not be sufficiently clear for observing the meteors. However, long before midnight, the principal stars in the neighbourhood of Leo began to show dimly through the mists, and, with a few intervals of obscurity, they remained visible until daybreak. Stars below the second magnitude were scarcely ever seen; and thus, while in general it would be impossible to mark the meteor courses, or observe the radiant with any precision, the expected display could not fail to be noticed had it taken place. That it did *not* take place, at least to any striking extent, within view of this locality, will be seen from the following, which I copy from my notes made during the night:—

From midnight to near 4h. A.M., sky misty. Principal stars about Leo dimly visible.

4h. A.M.—Overcast with light cirro-cumuli.

4½h.—Cleared away. Leo well seen.

5h.—Overcast with a broad sheet of vapour; no stars, but meteors might be seen. Moon visible, surrounded by a large halo.

5h. 20m.—Region of Leo, Cancer, Gemini, and Canis Minor pretty clear; the larger stars easily noticed up to 5h. 50m., when the sky became overcast with thin fleecy clouds. One meteor momentarily glimpsed through a rift.

6h. 20m.—A thick scud from the S.W. covered up stars and Moon, while on the east, the mist-banks over the sea were reddening in the daybreak.

6h. 30m.—Scud quickly replaced by a misty canopy, dense towards the west, but light enough from the zenith towards the east to prevent any moderately bright meteors moving in that direction to be seen.

7h. 30m.—The sky not so overcast, nor the daylight so strong as to prevent the observation of meteors; but up to this hour only the one above mentioned was noticed.

Scarborough: Nov. 15, 1867. J. BIRMINGHAM.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Here the weather has been completely unfavourable for the observations of November meteors. The watch was kept up during the two nights of the 13th and 14th November, to catch all the glimpses of uncovered sky, but with no profit at all. Fortunately enough, in the morning of the 14th, after a shower, the sky became clear, and half a dozen meteors were seen between 6h. and 6¼h. in a part of the sky about three-tenths clear. A few others were seen between 5h. and 5½h. in some breaks of the clouds. This fact is sufficient to prove that the appearance has taken place. If it has happened during our daytime, the Americans will tell us.

Here, Professor Respighi, looking at the sun, has seen some black dots passing rapidly before the disc; but he does not dare to say that they were meteors.

So a very troublesome labour has been rewarded with very little profit, but not entirely lost.

If you think that this notice may interest the Society, I beg you to present it to the members.

Truly yours,

Rome: Nov. 19, 1867. P. A. SECCHI.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—Though I kept watch here from midnight till daylight on the morning of the 14th inst., only one meteor was seen, owing to clouds which constantly covered the sky.

As this meteor must have been very brilliant from having been seen through thick mist, I have sent you a note of it, in the hope that it may be identified elsewhere. I fear, however, from its appearing at no high altitude in the north, that it will not have been observed at a station much south of this.

Meteor, yellow, with long train. Time, 5h. 22m. A.M. G.M.T. Arc 12°. Path, horizontal W. to E. Middle of path due N. Altitude 33°. Latitude of station 57° 10′; longitude 0h. 8m. 24s. W.

The evening of Monday, the 18th inst. was unusually fine, and ε Lyræ was easily double to my naked eye. On most moderately fine nights I can divide this object, but never did so before with such perfect ease.

Perhaps some of your correspondents will give their experience of this object, and suggest other tests for comparison of unassisted eyesight.

I remain, Sir, yours faithfully,

King's College, Aberdeen: DAVID GILL.
November 20, 1867.

POSITION OF METEORS.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

Sir,—In the outline, given in your last number, of the method of finding the height of meteors, I should perhaps have noticed the effect of the Curvature of the Earth.

It will occasionally happen that the observations of a meteor are both numerous and exact, in which case the correction for curvature should not be omitted, although there is nothing gained by determining the heights of meteors within a few yards. As a rule, the altitudes given are not nearly within a degree or two of the true altitudes, so that applying any correction to them would be absurd. As the curvature does not sensibly affect the *azimuths* employed, the point C (see figure, page 230) is sufficiently correct, but to determine the height of M, the observed altitudes at A and at B should be *increased* by half the angles which the sides A C and B C, respectively, subtend at the centre of the earth, which angles are readily found, since 10 English miles subtend 8·6 minutes, or 100 miles, 1° 26′, at the centre of the Earth.

I am, Sir, your obedient servant,

Southsea: Nov. 11, 1867. G. L. TUPMAN.

AT BIRMINGHAM, Mr. F. Bird observed seven meteors between 12h. 18m. and 14h. 36m. on the morning of the 14th November, after which the sky became overcast.

THE CORNHILL MAGAZINE for November contains a good popular article on Shooting Stars, Meteors, and Aërolites.

ASTRONOMICAL OCCURRENCES FOR DEC. 1867.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon —
Sun	1		Sidereal Time at Mean Noon, 16 39 26·7 Meridian passage of the Sun, 10m. 53s. before Mean Noon	1st Ec. R.	6 54 12	4 1·8
Mon	2			1st Sh. E. 2nd Oc. D.	4 5 8 10	4 47·2
Tues	3	0 54 22 21	Conjunction of Moon and Jupiter, 2° 0′ S. ☽ Moon's First Quarter	3rd Oc. R. „ Ec. D. „ Ec. R.	4 17 6 7 56 9 29 36	5 32·0
Wed	4	5 26	Near approach of Moon to φ Aquarii (4½)	2nd Sh. I. „ Tr. E. „ Sh. E.	6 2 6 15 8 51	6 16·7
Thur	5					7 2·0
Fri	6					7 48·7
Sat	7	3 55	Near approach of Moon to ν Piscium (4½)	1st Tr. I. „ Sh. I.	7 54 9 13	8 37·6
Sun	8	8 2 8 10	Occultation of B.A.C. 830 (6) Reappearance of ditto	1st Oc. D. 4th Ec. D. 1st Ec. R. 4th Ec. R.	5 15 5 28 23 8 49 48 9 25 42	9 29·5
Mon	9	3 18 3 43 11 33	Occultation of *f* Tauri (4) Reappearance of ditto Greatest westerly elongation of Mercury, 20° 53′	1st Tr. E. „ Sh. E.	4 43 6 0	10 24·9
Tues	10	3 51 4 24 5 40 6 53 15 21 16 17	Occultation, reappearance of 81 Tauri (5½) Occultation, reappearance of 85 Tauri (6) Near approach of Moon to Aldebaran (1) Near approach of Moon to σ^2 Tauri (5½) Occultation of B.A.C. 1526 (6) Reappearance of ditto	3rd Oc. D. „ Oc. R.	4 49 8 28	11 23·9
Wed	11	0 10 8 49 9 24	○ Full Moon Occultation of 130 Tauri (6) Reappearance of ditto	2nd Tr. I. „ Sh. I. „ Tr. E.	6 4 8 39 8 57	12 25·5
Thur	12	0 33 5 46 12 44	Conjunction of Saturn and Mercury, 0° 9′ N. Occultation, reappearance of 26 Geminorum (5½) Conjunction of Moon and Uranus, 4° 34′ N.			13 28·1
Fri	13	11 29 12 31	Occultation of 5 Cancri (6) Reappearance of ditto	2nd Ec. R.	5 33 19	Uranus — 13 22·0
Sat	14	19 33 21 30	Conjunction of Mercury and ν Scorpii, 0° 2′ S. Conjunction of Mercury and ν Scorpii, 9m. 6s. E.			13 17·9
Sun	15	15 7 16 21 19 5	Occultation of A Leonis (5) Reappearance of ditto Conjunction of Mercury and β^1 Scorpii, 11m.·7 W.	1st Oc. D.	7 14	13 13·8

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Uranus —
Mon	16	13 52 15 2	Sidereal Time at Mean Noon, 17 38 38·1 Occultation of *c* Leonis (5) Reappearance of ditto	4th Tr. I. 1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E. 4th Tr. E.	4 22 4 22 5 37 6 42 7 56 9 2	13 9·7
Tues	17	13 10 15 34	Near approach of Moon to β Virginis (3½) ☾ Moon's Last Quarter	1st Ec. R. 3rd Oc. D.	5 14 11 9 3	13 5·6
Wed	18		Meridian passage of the Sun, 3m. 19s. before Mean Noon	2nd Tr. I.	8 47	13 1·5
Thur	19	13 56	Occultation, reappearance of l^2 Virginis (5)			12 57·4
Fri	20			2nd Ec. R.	8 10 43	12 53·2
Sat	21			3rd Sh. I. „ Sh. E.	4 14 7 45	12 49·1
Sun	22	16 23 18 56	Conjunction of Moon and Saturn, 3° 11′ S. Conjunction of Jupiter and σ Aquarii, 1m.·4 E.	1st Oc. D.	9 13	12 45·0
Mon	23	21 44	Conjunction of Moon and Mercury, 4° 31′ S.	1st Tr. I. „ Sh. I. „ Tr. E.	6 21 7 33 8 41	12 40·9
Tues	24			1st Ec. R.	7 9 40	12 36·8
Wed	25	11 39 16 7	● New Moon Conjunction of Moon and Mars, 5° 15′ S.			12 32·7
Thur	26					12 28·6
Fri	27	16 49	Conjunction of Moon and Venus, 4° 42′ S.	2nd Oc. D	5 43	12 24·5
Sat	28	3 49 4 49	Occultation of B.A.C. 7097 (6) Reappearance of ditto	3rd Tr. E. „ Sh. I.	7 16 8 17	12 20·3
Sun	29			2nd Sh. E.	6 1	12 16·2
Mon	30	15 52	Conjunction of Moon and Jupiter, 1° 18′ S.	1st Tr. I.	8 21	12 12·1
Tues	31			1st Oc. D.	5 43	12 8·0

THE PLANETS FOR DECEMBER.

Mercury will rise during the first part of the month about two hours before the Sun, and will therefore be well situated for observation as a morning star.

		h.	m.	s.			°	′		
1st	R.A.	15	19	33	Decl.	–	15	39	Diameter	8″·0
15th	„	16	5	16	„		19	9	„	6″·0

Venus will now set later each evening, and at the end of the month is in a tolerable position for observation after sunset.

1st	R.A.	17	41	5	Decl.	–	24	13½	Diameter	10″·4
15th	„	18	57	54	„		24	5½	„	10″·8

Illuminated portion of the disk of Venus, 0·943.

Jupiter may still be seen in the south-west in the evenings.

1st	R.A.	22	10	11	Decl.	–	12	32½	Diameter	39″·4
15th	„	22	17	28	„		11	49½	„	37″·6

Saturn may now be observed in the mornings before sunrise.

1st	R.A.	15	45	15	Decl.	–	17	56	Diameter	15″·0
15th	„	15	51	54	„		18	16½	„	15″·0

Uranus is now well situated for observation, passing the meridian shortly after midnight at the end of the month.

7th	R.A.	6	52	8	Decl.	+	23	17½	Diameter	4″·2
19th	„	6	50	4	„		23	20	„	4″·2

Neptune may also still be observed, passing the meridian about 6 o'clock in the evening at the close of the year.

7th	R.A.	0	48	0	Decl.	+	3	23½
19th	„	0	47	43	„		3	22½

The Minor Planet **Vesta** will arrive at opposition this month; the mean opposition magnitude being 6·6.

1st	R.A.	6	41	13	Decl.	+	20	15½
15th	„	6	28	35	„		20	56½
31st	„	6	10	52	„		21	48

BRIEF CORRESPONDENCE.

SABRINA LAND.—In reply to D. T. K.—In 1838, Balleny discovered a projecting coast-line near 116° E. long., which was called Sabrina Land. In 1839, Charles Wilkes, U.S., discovered a coast-line near the Antarctic circle, including Sabrina Land, extending from 154° E. long. to 97° E. long. "The discoverers of these new countries have only in a very few cases been able to effect a landing, the coasts being skirted with a bank of either solid or broken ice, which generally extends from five to ten miles, and, in some places, to twenty miles from the shore. Between the mountain ridges valleys are observed, but they are filled with snow and ice nearly to the summits of the mountains, and these icy masses being converted into glaciers, protrude into the sea. In summer enormous pieces are broken off from them, and to this cause are owing the numerous icebergs which render the navigation along these coasts more difficult and dangerous than in the most northern latitudes which have been visited by our whalers."—(English Cyclopædia, Geograph. Div. Art. *Polar Countries.*) Not very promising as a station for observing the Transit of Venus! G. J. W.

THE MEMOIRS OF THE ROYAL ASTRONOMICAL SOCIETY.—The following information was obtained at the meeting on the 8th of November:—Volume xxxv. of the *Memoirs* will be issued to the Fellows of the Society at the price of 14*s.*, and to the public at 25*s.*; vol. xxxvi. will be *given* to the Fellows *on application* (in the same manner as the *Transactions of the Royal Society*). If a Fellow cannot call for it, he may send a messenger with a written application, but letters by post *cannot be attended to.* This volume will be sold to the public for 10*s.*; in the latter case containing the *Monthly Notices* in the quarto form, which the volumes given to the Fellows do not contain.

INSTRUMENTS, &c. FOR SALE.

These Notices, which are restricted to *two lines* each, are inserted free of charge to subscribers: applications respecting prices and other particulars to be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—For Advertisements with prices and more complete details, a small charge will be made.

N.B.—It is particularly requested that we may be informed when instruments are disposed of, in order that the notice may be withdrawn, and fruitless applications prevented.

Achromatic Refractor, 6·4 in. ap. 8½ ft. focus, by *Merz*, equatorial and clockwork by *Troughton & Simms.* [73]

Achromatic Refractor, 4 in. aperture, by *Cooke & Sons*; equatorially mounted, complete in every respect. [104]

Achromatic Refractor, 4 in. aperture, by *Cooke & Sons*, with or without equatorial stand, complete. [115]

Achromatic Refractor, 3¼ in. ap. 50 in. focus, with brass tripod, comet, landscape, and 4 other powers 74 to 260. [111]

Gregorian Reflector, 4¾ in. ap. 2 ft. focus, by *Dollond*, 4 powers, 50 to 200, finder, &c., on brass table stand. [63]

Achromatic Object-Glass, 4⅛ in. ap. 62 in. focus, by *Slugg*, with brass cap and receiving cell, for mounting on tube. [85]

Transit Instrument, 3¾ in. ap. 5 ft. focus, Ys fitted with agates for mounting on stone piers. [29]

Transit Instrument, 2¾ in. ap. 30 in focus, by *Troughton & Simms*, with micrometer eye-piece and cast-iron adjustable stand. [107]

Equatorial Stand, for 5 ft. telescope: with circles, &c. complete. [99]

Equatorial Stand, for a 5 or 6 ft. telescope: 13 in. circles, divided on silver, to 10″ of space and 4s. of time.—Has never been used. [55]

Polar Axis, of mahogany, 7 ft. long, adapted for a 4 ft. telescope, with 12 in. circles, reading to minutes. [56]

Tube of handsome polished mahogany, suitable for O.G. of 8 in. ap. and 9¼ ft. focus; brass mountings, 2 in. finder, and illuminating apparatus, complete. [116]

Right Ascension and Declination Circles, 10 in. [109]

Speculum Grinding Apparatus, capable of working a 7 ft. speculum: with tube and fittings for a 9 in. Newtonian. [57]

Astronomical Clock: zinc and steel compensation; price low. [114]

Pair of Globes, 21 in. diameter, on high stands, by *Cary*. [117]

Smyth's Cycle of Celestial Objects: 2 vols. in good condition. [118]

Recreative Science: and the first three volumes of the **Photographic Journal:** price very low. [30]

Lalande's Astronomy, 2 vols. 4to. [108]

INSTRUMENTS, &c. WANTED.

Astronomical Clock, not very first-class; price low. [65]
Equatorial Stand, for a 5 ft. Refractor: graduated circles. [35]
Brass Tripod for a 2 ft. Telescope: condition not material. [106]
Transit Instrument, 2 in. ap. 18 or 24 in. focus. [71]
Transit Instrument, 1½ in. aperture, about 20 in. focus. [102]
Monthly Notices of the Royal Astronomical Society, Vol. 3. [26]
Monthly Notices: Vol. 5, No. 12. [82]
Bartholomew Prescot on the **Universe,** published 1823: a copy wanted, in good condition. [84]
Galbraith's Mathematical and Astronomical Tables, 2nd edition. A good price will be given for a clean copy. [105]

OBSERVATIONS OF LINNÉ.—The following circular has been issued by Mr. Birt on behalf of the *Lunar Committee*:—"The accurate measures made by Mr. Huggins on July 9, 1867, of this object, *including the bright margin*, viz. 1″·7 (*Monthly Notices R.A.S.*, vol. xxvii. p. 296), the announcement by Herr Tempel that on July 22, 1867, it appeared to him as being then filled up (*Astronomische Nachrichten*, 1655), and no information respecting it having been received by the Committee since July 9, rendered it desirable that observations of the large white spot should be resumed with the view of ascertaining the state of the *large shallow crater* and of the orifice (*small crater*) within it. It is also important that measures of the small crater should be made at least once in every lunation. —P.S.—Contemporaneous observations of the mountain γ Posidonius, also of the black point on its summit, will be valuable in connection with the present state of Linné."

LIST OF SUBSCRIBERS—Names received since our last number.

Andrews, W., Esq., Gosford Green, Coventry.
Heinemann, Armin, Esq., Ordnance Factory, Enfield Lock.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1867.
Cooke, T.
Dawes, Rev. W. R.
Heinemann, A.
Lancaster, W. L.
Metcalf, Rev. W. R.
Welsford, J.

To March 1868.
Elger, T. G. E.
Herschel, A. S.
Oldfield, W.

To June 1868.
Andrews, W.

To December 1868.
Gilby, J.
Varley, C.

NOTICE TO CORRESPONDENTS.

Papers by E. Brayley, P.S., and An Old Subscriber, are in type, but deferred for want of space.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**